Leyland

SERVICE MANUAL

MODEL

"LYNX" VK 07

CHASSIS Nº

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LEYLAND MOTORS LTD

LEYLAND LANCS

THE

CARE AND MAINTENANCE

OF

LEYLAND

GOODS VEHICLES

LEYLAND MOTORS LIMITED

HEAD OFFICE AND WORKS : LEYLAND, LANCS.

FOREWORD

THE object of this Manual is to enable engineers in charge of Leyland vehicles to run and maintain them with the excellent results that are so characteristic of the Leyland design.

In it we have endeavoured to describe, both in the text and by means of illustrations, the salient features of the design, the recommended methods of maintenance and the location of faults. Each unit is treated separately and fully illustrated, and the information is conveniently grouped together so as to be available at a moment's notice.

Though large fleet owners may have their own methods of maintenance, we commend the detailed notes of the component particulars to them as well as to those in charge of individual vehicles, as a careful study of the pages which follow will prove not only informative and instructive, but will, we trust, to some extent supplement the advice and practical assistance which is always available at our many Service Depots and from our travelling Service Mechanic Inspectors.

IMPORTANT NOTE

MODIFICATIONS in design which affect any of the operations outlined in this Manual will be covered by the addition, as and when required, of amendment pages to the appropriate section.

It is therefore recommended that operators, when consulting the Manual, should ascertain if any such amendment has been added before commencing adjustment or overhaul.

GUARANTEE

All vehicles and chassis and spare parts are subject only to the following express warranty which shall exclude all conditions, warranties and liabilities whatsoever, whether statutory or otherwise, which might exist but for this provision.

In the event of any defect being disclosed within a period of 12 months after the date indicated below, the Company undertakes, provided the part alleged to be defective is returned immediately to the Company's Works for purposes of examination, to repair the defective part or to supply a new one in place thereof free of charge if on examination by the Company the part so returned is found to be faulty in its material or workmanship. Such free replacement or repair does not include carriage charges to and from the Company's Works, nor the cost of installing the new or repaired part.

This warranty does not apply to tyres, nor to any electrical fittings, accessories, proprietary or other articles which are not adopted by the Company as recommended standard equipment on the Company's vehicles.

This warranty does not apply to defects caused by wear and tear, overloading, misuse, dirt or neglect, nor to any parts which may have been damaged by reason of defect in some other part. The Company does not accept liability for any contingent or consequential damage which may arise under any circumstance whatsoever.

This warranty is limited to the party in whose name the vehicle is first registered as the user thereof, and runs from the date of invoice, unless such user notifies the Sales Department of the Company of the date on which the vehicle is first put into service by him, in which case, such date, if agreed by the Company, will be registered as the date for the commencement of the running of this warranty.

In the event of the vehicle being modified or any identification plates, numbers or marks being altered or removed, the Company's liability under this warranty ceases forthwith.

CHASSIS AND ENGINE SERIAL NUMBERS

The serial number of the chassis is stamped on a plate which is fixed on the near side of the frame at the front end. The engine number is stamped on a plate fixed to the cylinder head cover.

When writing for spares, guarantee claims, or in any connection whatsoever relating to the vehicle, always quote chassis and engine serial numbers.

DELIVERY

The chassis is thoroughly tested and rigorously inspected before leaving the works, so that the vehicle is in a suitable condition to proceed directly on service.

At the same time it is advisable to avoid excessive speeds for the first 500 miles, until all part are completely "run in." Strict attention should be given to lubrication during this period to ensure that no part is allowed to run in a dry condition.

Before putting the machine into service the following points should be given attention :— See that—

(*a*) Radiator is filled.
(*b*) Fuel supply is adequate.
(*c*) Engine, gearbox and axle have requisite quantities of oil.
(*d*) All grease and oil nipples on the chassis have been lubricated.
(*e*) Engine oil-pressure is correct.
(*f*) General performance is up to standard, i.e., quiet running, efficient brakes and electrical equipment in good order.
(*g*) Tool kit is checked.

Instruct drivers that the vehicle is a new and high-class machine, and as such warrants careful attention during its early life. A great deal of harm can be done in the first few hundred miles through negligent driving.

In view of the numerous makes of high-grade oils and greases on the market which are suitable for Leyland chassis, it is impracticable to list all the brands possessing the necessary qualities.

The characteristics desirable in lubricants for the various parts of the chassis are, therefore, given below.

It should be pointed out that the lubricants should have been manufactured under carefully controlled conditions and should be free from dirt or any harmful substance.

ENGINE OIL:

PETROL ENGINES.

Viscosity (Redwood 1): not more than 83 seconds at 200°F. and not less than 73 seconds at 200°F.

OIL ENGINES.

(Summer - April to September).

Viscosity (Redwood 1): not more than 2,500 seconds at 70°F. and not less than 63 seconds at 200°F.

OIL ENGINES.

(Winter - October to March)

Viscosity (Redwood 1): not more than 1,600 seconds at 70°F. and not less than 55 seconds at 200°F.

Cold test (pour point I.P.T. method L.O.11, 1924): must not exceed 15°F., preferably below 10°F.

OIL ENGINES.

(Special Winter grade)

For users experiencing difficulty in starting oil engines as a result of their being left in exposed positions, we have found an oil having the following specification, to be satisfactory.

Viscosity (Redwood 1): not more than 1,000 seconds at 70°F., and not less than 58 seconds at 200°F.

Cold test (pour point I.P.T. method L.O.11, 1924) must not exceed 15°F. preferably below 10°F.

GEARBOX:

SLIDING-PINION TYPE GEARBOX AND CONSTANT-MESH GEARBOX WITH NEEDLE-BEARING THIRD-SPEED WHEEL (1936 AND ONWARDS).

A high-grade gear oil should be used having Viscosity (Redwood 1) of not less than 95 seconds at 200°F.

Alternatively the oil recommended for worm-driven rear axles may be used. Oils which thicken after some time in use are not suitable and the use of a soap-thickened oil is not recommended, while grease must not be used.

(Contd).

CONSTANT-MESH TYPE GEARBOX WITH PLAIN-BUSHED 3RD SPEED WHEEL (BEFORE 1936)

A thin type of gear oil with the following characteristics must be used.

Viscosity (Redwood 1): not more than 425 seconds at 140°F and not less than 95 seconds at 200°F.

Cold test (pour point I.P.T. method L.O.11, 1924): must not exceed 20°F.

Ash: Not more than 0.05 per cent.

Colour: When viewed by reflected light, green or amber.

An oil approximating to these characteristics can be made by mixing two parts of oil to the specification recommended for petrol engines with one part of the oil suggested for worm-driven rear axles.

AUXILIARY GEARBOX.

A high-grade gear oil should be used, such as is recommended for use in the sliding-pinion type gearbox.

TORQUE CONVERTER:

CONVERTER FLUID.

Use only best quality, high-boiling kerosene (paraffin) free from dissolved gas, to which is added 5 per cent. of engine oil

REVERSE GEARBOX OIL.

Lubricate with engine oil, do not use gear oil or grease.

REAR AXLES:

WORM AXLES.

We have found oils having the following characteristics to give satisfactory results in worm-driven axles:-

Specific gravity: Not more than 0.925.

Viscosity (Redwood 1): not more than 1,100 seconds at 140°F, and not less than 155 seconds at 200°F.

Cold test (pour point I.P.T. method L.O.11, 1924): must not exceed 35°F.

Mineral oil: Not less than 80 per cent.

Ash: Not more than 0.05 per cent.

Colour: When viewed by reflected light, green, greenish brown or amber.

BEVEL AXLES.

An oil as heavy as the above is not essential for bevel-driven axles. For these a high-grade gear oil, such as is indicated for Sliding-Pinion type Gearboxes, may be used instead of the oil given above if preferred.

STEERING GEAR, FRONT AXLE AND STEERING JOINTS, CHANGE-SPEED BOX, SPRING SHACKLES:

Use a high-grade gear oil, such as is indicated for Rear Axle, Do not use grease.

(Contd).

ROAD-WHEEL BEARING:

High-grade grease as recommended by manufacturers and approved by British Timken, Ltd..

CLUTCH SPIGOT BEARING:

Only high-melting-point grease to be used. Attention required only when at overhaul.

WATER PUMP:

CARBON-GLAND TYPE PUMP.

High-grade grease

SPICER COUPLINGS:

PLAIN-BUSH TYPE.

Use only one of the fibrous greases made specially for this purpose and approved by Hardy Spicer & Co. Ltd.

NEEDLE-BEARING TYPE.

Use a high-grade oil having the following characteristics:-

Viscosity (Redwood 1): not more than 5,200 seconds and not less than 2,600 seconds at 100°F.

Consistency: Must not channel in service at a temperature of plus 35°F.

SHOCK ABSORBERS:

LUVAX.

Use only Luvax oil as recommended by Luvax, Ltd.

NEWTON.

Use only Newton Patent Emulsion as recommended by Newton & Bennett, Ltd.

BRAKE SERVOS:

CLAYTON-DEWANDRE.

Use only engine lubricating oil.

WESTINGHOUSE.

For cylinders use Paragon grease as recommended by the Westinghouse Co.
For servo pivot-shaft use engine oil.

LOCKHEED BRAKES:

Use only geniune Lockheed Brake Fluid as recommended by Automotive Products Co. Ltd.

ALL OTHER CHASSIS POINTS:

See Lubrication Chart.

SECTION 4A

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GENERAL DESCRIPTION

In view of present-day traffic conditions on the roads, it is essential that the driver of any vehicle should be able to operate his controls without his attention being distracted from the road. This necessity for concentrated attention has been carefully studied when arranging the controls in the driver's cab.

The gear lever is on the left of the driver, the handbrake lever on the right. The clutch, brake and accelerator pedals are conveniently situated. All controls are exceptionally light to operate so that undue fatigue should not be experienced even after prolonged spells of driving.

The horn button and dimmer switch are fitted on the steering column, while the controls for such auxiliaries as windscreen wiper and fog light are within easy reach of the seated driver.

DRIVING

The gear change on Leyland vehicles is of the ball type and the positions of the lever are shown in Fig. 1. For reverse lift the lever, move over to the left as far as possible and then back. Under normal conditions second gear can be used when moving off, but on hills or when drawing a trailer botom gear should be used. In the interests of petrol economy top gear should be engaged as soon as possible and allowed to remain engaged so long as conditions permt. The engine is extremely flexible and top gear can be used down to low speeds and a good pick up obtained. **Do not on any account resort to slipping the clutch instead of changing to a lower ratio, but donot racethe engine in intermediate gears.**

An efficient clutch stop is provided to facilitate quick changing on hills, but under normal conditions the clutch pedal does not require depressing to its full extent.

On machines fitted with coil ignition the advance is entirely automatic. In the case of magneto ignition the manual control should be fully advanced provided this does not cause excessive pinking. A certain amount of pinking can be disregarded as all engines have the ignition set so that there

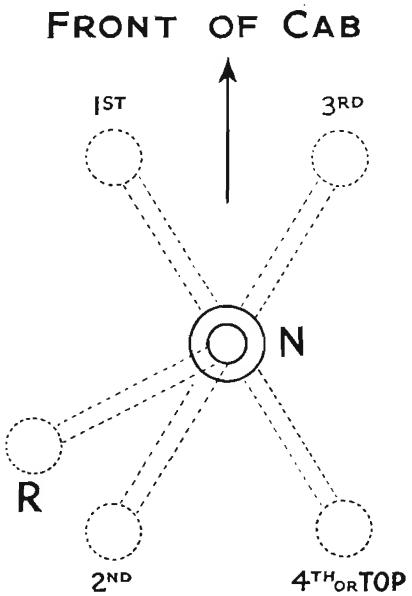

Fig. 1.
Positions of Change-Speed Lever.

CONTROLS AND OPERATION

will be slight pinking on full throttle at 15-20 m.p.h.

Running with retarded ignition will cause overheating and excessive consumption.

Do not coast in neutral gear.

Use footbrake for service, the handbrake is intended for parking and emergency.

Watch the indicator lights on the dash, their significance is fully described under "Electrical Equipment."

STARTING

Before attempting to start the engine check that :—

1. Petrol tank is full (gauge provided on tank).
2. Engine oil level is correct (dip stick).
3. Radiator is full.
4. Petrol is turned on.
5. Ignition is switched on.
6. Gear lever is in neutral.

It is advisable, especially during cold weather, to turn the engine over once or twice by hand, with the ignition switched off, to free the pistons and avoid overloading the battery when a starter motor is fitted.

Switch on and, in the case of magneto ignition, fully retard the manual control. Press the starter button and if the engine does not start in five or six revolutions do not keep the starter running but find the cause of failure to start.

After starting allow the engine to warm up for several minutes ; an increase in engine speed will be noticed when the starter is automatically cut out by the thermostat control. While it will be found that the machine can be driven away immediately after starting, it is strongly recommended that the engine should be allowed to warm up before moving off, to allow the oil time to circulate.

FAULTY STARTING

Starter Motor.

If the starter motor fails to turn the engine, switch on the lights and if they are dim the battery may require recharging or the connections may be loose or corroded. If the lights are bright but become dim when the starter is engaged, check that :—

1. Gear lever is in neutral.
2. Starter motor is not jammed.
3. Engine is quite free by turning with the starting handle.

If the lights are bright but become dim when the starter button is pressed and the starter motor does not engage, examine the connections (see Wiring Diagram).

Petrol Supply.

Prime the carburetter by operating the hand lever on the petrol pump, check that there is petrol in the tank and that the tap is turned on. If petrol does not reach the carburetter, clean the petrol pump filter (see "Petrol Pump" in "Engine Auxiliaries").

If petrol is reaching the carburetter and engine will not start, check that the bi-metal strip in the thermostat control is uncovering the pipe and see that the starter throttle valve has not stuck. Try compression on each cylinder to see that valves are seating.

Ignition.

See that the ignition switch is on.

Remove any ignition cable from a plug and hold the end about ¼ in. from any metal part of the engine and watch for spark when the engine is turned by hand. With coil ignition the fingers should be at least 3 in. from the end of the cable when doing this. If there is a good spark, check the ignition timing, remove the plugs and see that they are dry, clean and free from internal shorts. If the plugs are moist, dry them and replace ; should the engine start, tighten all cylinder head nuts when the engine is hot. If the moisture is excessive and a considerable loss of water from the radiator has been noticed, the cylinder head gasket should be renewed.

If there is no spark at the plugs, with coil ignition :—

1. Switch on lights to test if battery is discharged ; even if the battery can only make the lamps glow, it should be sufficient to start the engine.
2. If the battery is dead, test with a voltmeter across individual cell terminals to see if there is battery fault ; if not, locate cause of battery discharge.
3. If the battery is in good condition, check that the switch is making good contact. The red lamp on switchboard should glow when ignition is switched on unless the contact breaker points are open.
4. Examine the low tension wiring for breakages or loose connections.
5. Remove distributor cap and examine the contact breaker points. The surfaces of the points should have a greyish frosted appearance ; if badly pitted, rub the surfaces together by moving the breaker arm up and down. The arm should then be opened and allowed to spring back to the fixed point several times, care being taken that the points are not chipped by springing back too hard. If the points are oily they should be wiped with a clean rag moistened with petrol, care being taken to allow petrol to evaporate before replacing the cover.
6. See that the points have the correct gap and are making and breaking.
7. If the engine will not start remove the high tension terminal from the distributor and hold it ¼ in. from some metal part of the engine. Switch on and the sparking should be strong and regular when the engine is turned by hand.

   If only a weak spark is obtained, in the case of earth-return systems, disconnect the low tension lead between the distributor and coil and connect a 12 volt lamp between the coil terminal and earth. The lamp should light, if it does not, transfer the wire of the lamp to the other coil terminal and if the lamp now lights the coil is defective and should be replaced. If the lamp does not light the fault is in the wiring or battery.

   In the case of insulated return systems, disconnect the low tension lead between the coil and distributor at the distributor terminal and connect a 12 volt lamp between the end of this wire and the other distributor terminal. The lamp should light ; if it does not, transfer the wire of the lamp to the other coil terminal and if the lamp now lights the coil is defective and should be replaced. If the lamp does not light the fault is in the wiring or battery.
8. See that the earth wire (on earth-return) or return wire (on insulated-return) is making a good connection and is not broken.

In the case of magneto ignition :—

1. Check that the switch is on.
2. Remove the contact breaker cover and try to start engine, if it starts the wire or switch is earthing.
3. Examine contact breaker, see that the arm is not sticking, that contact breaker points have correct gap and are clean and flat.
4. Remove distributor cover and see that rotor blade and segments are not burnt.

CONTROLS AND OPERATION

ERRATIC RUNNING

This may be due to any of three causes.

1. Ignition.
2. Valves.
3. Carburation.

Ignition.

If the engine appears to be misfiring on one cylinder, short each plug in turn until the defective cylinder has been located. Examine the plug in that cylinder and check the gap; with coil ignition this should be .020 in., with magneto ignition .016 in. See that the points are clean and insulation sound.

If coil ignition, see that there are no loose or dirty connections and that the contact points open .015 in. Check that the points are in good condition.

With magneto ignition keep the contact points at .016 in. gap and check that the safety spark gap is 10 mm. Check that the distributor segments are free from oil.

In both cases examine the insulation of the high tension cables and if it is perished or chafed replace the cables, pressing the ends well home in the sockets.

Valves.

Check that the rocker clearances are .020 in. inlet and exhaust when cold. Warped or burned valves caused by insufficient clearance will result in misfiring. If the tappet clearances are correct, see if any valves are sticking. A sticking exhaust valve is indicated by an explosion in the silencer and a sticking inlet valve by violent blow back in the carburetter.

Weak or broken valve springs will cause bad running, the former at fairly high speeds, the latter at ordinary running speeds.

Carburation.

If the engine starts but will not continue to run when the starter cuts out, see if the idling passage in the carburetter is choked or if the idling adjustment is at fault.

Examine for air leaks in the induction system caused by loose flange joints or badly worn valve guides. If the compression is poor, examine pistons for badly fitting rings and valves for correct seating. Black smoke from the exhaust and hunting indicate an over-rich mixture. Check that the air supply to the slow running jet is not choked and that the thermostat control is cutting out the starter.

For popping back when accelerating inspect for water in the petrol, this may also be caused by a cold engine.

If popping back occurs at high speed check the filters for stoppages and fuel pump for correct operation. See that the ignition is sufficiently advanced and that there are no valves sticking.

LOSS OF POWER

A general falling off in power may be caused by the following :—

Brakes partially on; feel the brake drums, hubs and axle for overheating.

Overheating and loss of water from the radiator indicate a leaking gasket.

Oil level and pressure may be low.

Insufficient spark advance.

Faulty or unsuitable plugs and heavy carbon deposit will cause pre-ignition and consequent loss of power.

Choked silencer—remove and clean out.

Clutch slip—test in second gear with handbrake hard on.

Poor compression due to general wear in piston rings and valves.

After overhaul the valve or ignition timing may be incorrect.

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GENERAL NOTES

The arduous conditions under which modern commercial vehicles operate and the regulations with which they must comply, necessitate their being maintained in a high state of efficiency. The most satisfactory method of keeping machines in this state is by a system of routine inspections during which minor defects can be detected and rectified. A system of drivers' daily reports on vehicles will, if the defects reported are immediately rectified, prevent them developing and possibly necessitating expensive repairs and costly delays in service. A weekly check on such items as filters, batteries, springs, engine compression, brakes and tyres can be followed by a more detailed monthly inspection with the machine over a pit. These inspections, followed by docking and overhaul at longer intervals, should result in trouble-free service throughout the life of the vehicle.

CHASSIS LUBRICATION

Thorough lubrication of all chassis parts is essential for successful operation and this must be done regularly using the correct grade and quantity of lubricant—spasmodic application of lubricant is useless. The lubrication system is arranged as simply and accessibly as possible and a list of recommended types of lubricants is given in Section 2. Detailed instructions for lubrication of all units are given in the appropriate sections and these instructions should be adhered to.

Lubricate according to the chart.

The lubrication instructions for the main units may be summarised as follows :—

Engine.

Inspect oil level daily and replenish to level on dip stick. Petrol engines—change the oil after the first 5,000 miles and then every 10,000 miles. Oil engines—change after the first 2,000 miles and then every 6,000 miles.

Gearbox.

Inspect weekly and fill to level of filler hole. Renew oil every 20,000—25,000 miles.

Auxiliary Gearbox.

Inspect and replenish weekly. Change oil every 20,000—25,000 miles.

Transmission.

Replenish centre-bearing weekly.
Spicer—Lubricate couplings and sleeves monthly.
Layrub—Couplings require no lubrication.

Road Wheel Bearings.

Examine when docking, replenish with grease if necessary. Re-pack at overhaul.

Rear Axle.

Inspect and replenish weekly. Change oil every 20,000—25,000 miles.

Steering Gear.

Lubricate ball-pins daily.
Marles type — Lubricate steering-box weekly.
Worm and Nut type—Remove steering-box plug monthly and replenish.

Road-Spring Shackles.

Lubricate daily.

Front Axle.

Lubricate king-pins weekly.

MAINTENANCE

MONTHLY INSPECTION

The monthly inspection should be made over an inspection pit, the following points receiving particular attention, checking that :—

1. All parts requiring lubrication are receiving lubricant.
2. All pipes from lubrication batteries are in good condition, not fractured or chafed.
3. There are no leaks from the main units.
4. Steering connections are sound and well lubricated and no play is developing in steering gear.
5. Brakes are operating efficiently and all brake connections are sound. No leaks from pipes where hydraulic brakes are fitted and tank is full.
6. Clutch is operating properly and has correct pedal clearance.
7. Spicer couplings are lubricated, flange bolts are tight and split pinned, companion flanges are tight on shaft ends.
8. There are no loose bolts and no split pins missing.
9. No side play in road-spring shackles and nuts on clips securing springs to axles are dead tight.
10. There is not undue rock in road wheel bearings.
11. Compression is good on all cylinders, cylinder head nuts tight and valve clearances correct. Remove and clean engine oil-filter element. On petrol engines see that ignition leads are in good condition, contact points have correct gap, plugs are clean, have correct gap and no internal shorts. On oil engines clean out fabric fuel-filter and air-filter, nozzles may be checked for spray and fuel feed pipes examined.
12. Dynamo and starter-motor terminals are clean and all connections tight, wiring is sound. Battery is well charged and acid-level correct, terminals cleaned and greased.
13. Inflation pressures of tyres are correct and wheel nuts tight.

DOCKING

The period between docks must necessarily vary according to the type of work upon which the vehicles operate and the facilities for such work at the operator's disposal. Generally, however, docking should take place every 7,000—10,000 miles.

Docking may be said to consist of the inspection outlined under "Monthly Inspection," with the addition of all adjustments, renewals and repairs necessary to keep the vehicle in a highly efficient condition. Decarbonising, valve grinding, sump cleaning, brake relining and a thorough examination of all units should take place at this time. On petrol engines the ignition system should be carefully inspected and adjusted, carburetter cleaned and operation checked. On oil engines the nozzles may be checked for spray and all fuel feed pipes examined.

The fuel system should be cleaned and inspected for chafed pipes and loose connections, particular attention being given to all filters on oil-engined vehicles. The vehicle should then be in a state to give trouble-free service until the next dock.

OVERHAUL

A complete overhaul should be given at from 70,000—100,000 miles. At overhaul all units should be stripped and the necessary renewals and adjustments made after which the chassis should be in new condition.

SPECIAL NOTES

Taper Fixings.

These are used for securing such parts as coupling-flanges and should not be disturbed unless absolutely necessary. When replacing, make sure that the taper surfaces are clean and free from abrasions. If a new key is fitted it must not bottom in the keyway.

The method of fitting when assembling at the works, can profitably be used by operators when refitting flanges. Coat the shaft with a thin layer of marking blue and pull the flange up hard by tightening the nut. Withdraw the flange and see that the taper shows a perfect marking. If it does not, smear the face of the shaft with carborundum paste and grind the flange to it. Clean off all abrasive and immerse the flange in boiling water for half an hour. Wipe the flange quite dry with a dry rag and fit on the shaft. Pull the nut up dead tight, using the special spanner and a heavy hammer. On no account must the nut be slacked back to bring the pin holes into line.

Should a key shear due to careless assembly, the new key should be in the special key steel as obtained from Leyland Service Depot.

A special drawer can be obtained for drawing coupling flanges off their shafts.

Taper Setscrews.

Selector forks and collars are located on their shafts by taper-ended screws. When fitting these screws, see that the taper part beds in the taper hole in the shaft and does not bottom. Check by marking as for taper fixings.

Oil Seals.

Leather oil-seals are fitted in gearboxes, axles and other parts of the chassis. Great care should be taken not to damage these seals when removing or replacing parts.

The seals are a tapping fit in their housings and care must be taken not to bend or damage the metal casing. Likewise when replacing or renewing seals, they should be carefully tapped or pressed into position. The leather lip must face inwards. This lip is slightly less in diameter than the shaft or sleeve on which it seats. Care must be taken that this lip is not damaged when removing or replacing parts.

In the event of damage to the seal, or if the leather has become hard and perished, a complete new seal should be fitted.

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ENGINE

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GENERAL DESCRIPTION

The Leyland Light-Six Petrol engine is of the push-rod operated overhead-valve type.

In developing this unit the inherently successful features of the earlier engine have been retained, the modifications embodied resulting in a greatly increased power output and improved accessibility.

All auxiliaries and parts requiring periodical attention are arranged so that the necessary routine adjustments can be carried out in the minimum time.

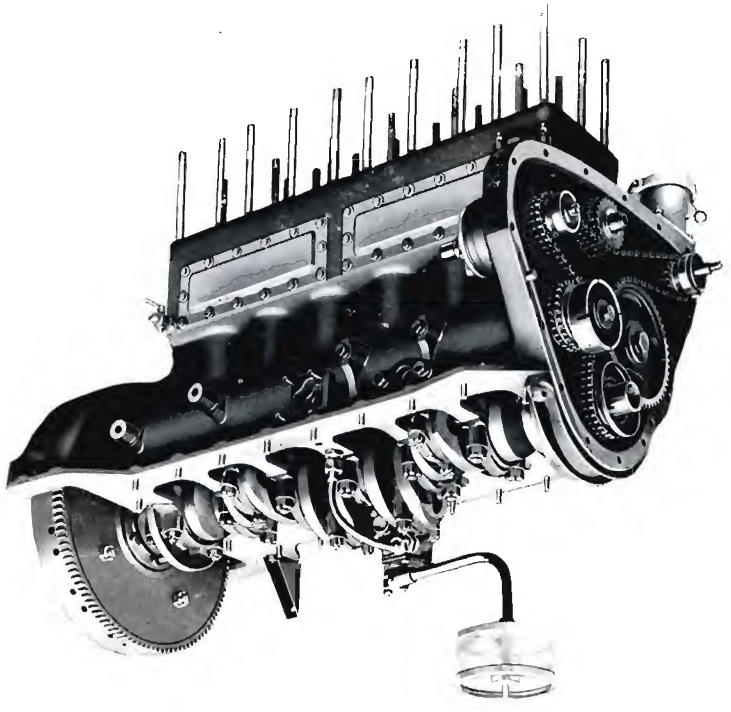


Fig. 1.
OIL PUMP AND SIEVE IN POSITION.

LUBRICATION SYSTEM

Pressure lubrication is provided by means of a gear type oil pump shown in Fig. 1, housed in the crankcase below the camshaft, by which it is driven through skew gears. The deep sump, shown in Fig. 2, carries two gallons of oil as indicated by the "full" mark on the dipstick and is provided with a gauze sieve into which the suction pipe dips. Later models have a two-piece sump (not shown in these illustrations (which provides improved accessibility and facilitates draining and cleaning operations. The pump draws oil from the sump and forces it by way of an external cooler and filter and internal oil passages to the main bearings, whence the oil is directed by tubed oilways in the crankshaft to the big ends. The pump also delivers oil through a cored passage to the timing case and by a pipe from the main gallery to the rocker shafts. Excess oil from the cylinder head returns to the sump down cored oilways in the head and block. Fig. 7 shows the oil circulation diagram.

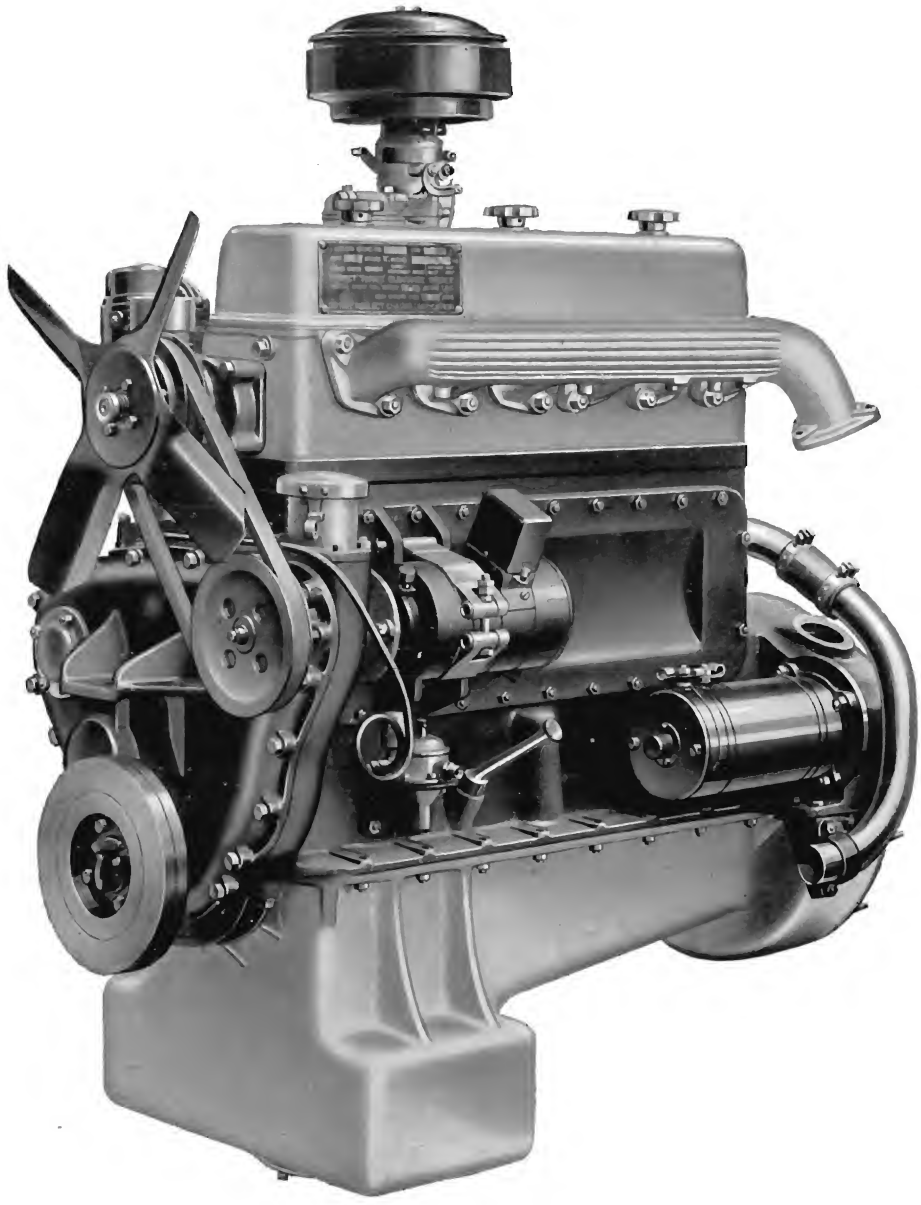


Fig. 2.
THE LIGHT-SIX PETROL ENGINE.

MAINTENANCE OF LUBRICATION SYSTEM

Fig. 3.
OIL SIEVE REMOVED.

Check the oil level daily by means of the dipstick and replenish if necessary with high-grade engine oil of a specification given under "Lubricants."

Draining Sump.

It is advisable to change the engine oil after the first 5,000 miles and then every dock at 7,000-10,000 miles. The one-piece sump can be drained by removing the plug shown in Fig. 3, the plate and sieve should then be removed and the sieve thoroughly cleaned in paraffin before replacing. When replacing make sure that the joint is in good order to avoid leakage.

Oil Pressure Relief Valve.

The pressure relief valve is housed in the oil cooler head and is readily accessible. The adjusting screw is enclosed in a cap which must be removed if any adjustment becomes necessary. To adjust the valve, remove the cap as shown in Fig. 4 and take out the pin locking the adjusting screw; screw in to increase and out to reduce the pressure. Replace the pin after making the adjustment.

The normal pressure shown on the gauge should be 40 lb. per sq. in. with the engine hot and running at normal road speed; always carry out the adjustment with the engine running.

Removal of Relief Valve.

The relief valve can be removed for cleaning as shown in Fig. 6, after taking off the cap (5) screw the adjusting screw (4) right out and withdraw the spring (3) and valve (2).

Oil Pump.

The oil pump is of the gear type having one pair of wide gears. It is secured to the crankcase by two studs and driven through skew gears by the camshaft. No attention should be required.

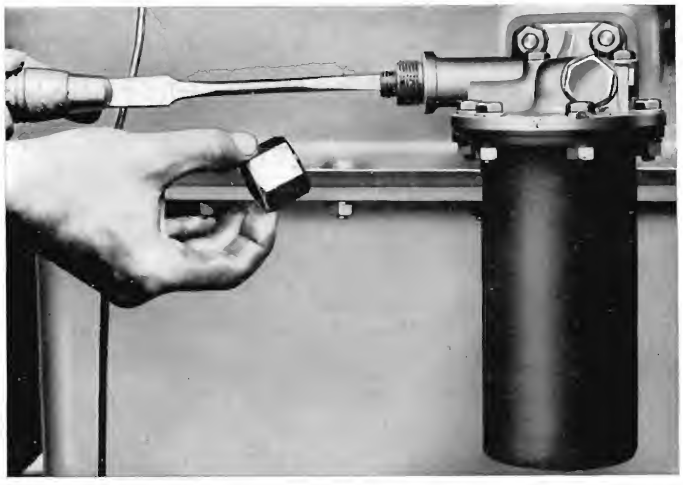


Fig. 4.
ADJUSTMENT OF RELIEF VALVE

ENGINE

Removal of Oil Pump.

If necessary the pump can be removed, after dropping the sump, by disconnecting the main oil delivery pipe and taking off the two nuts securing the pump to the crankcase.

Dismantling Oil Pump.

To dismantle the oil pump, take off the locking wire (3), Fig. 10, and remove the six setscrews securing the cover and remove the cover. The idler gear spindle (4), Fig. 9, can be punched out from the top, the skew gear (1) on the upper end of the driving spindle is secured by a taper pin. Drive out the taper pin and the spindle can be drawn through the skew gear. The pump driving gear is keyed on the spindle and secured by a circlip.

When reassembling the pump, make sure that the paper washer (10) is replaced and wire up the setscrews securing the base plate. When replacing the pump check that there is slight backlash in the skew gears.

Loss of Oil Pressure.

This is most probably due to dirt in the pressure relief valve which should be removed and thoroughly cleaned. If pressure is still low, inspect the pipes for fracture or loose unions ; slack bearings will cause loss of pressure.

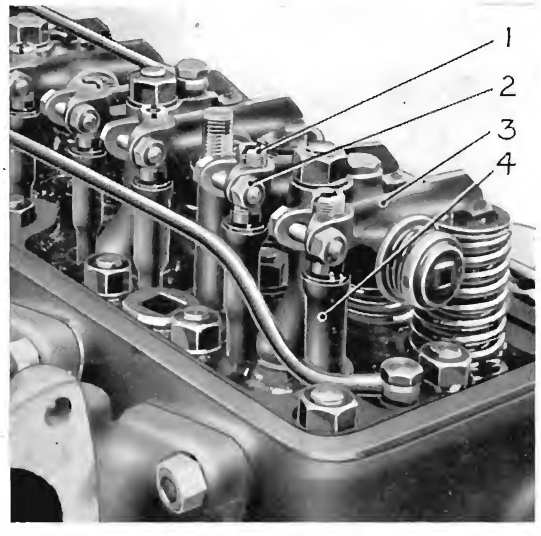


Fig. 5.
VALVE ADJUSTMENT.
1. Valve Adjusting Screw.
2. Clamp Bolt for Adjusting Screw
3. Rocker Lever.
4. Push Rod.

VALVES AND VALVE ADJUSTMENT

The valves are operated through push rods and overhead rocker gear. The exhaust valves are of different material from inlet valves and can be distinguished by the difference in size, the inlet valves being the larger as shown in Fig. 11

Double concentric springs of varying pitch are used, the valves being located by split conical cotters (5) which seat in collars (3). There should always be $\frac{1}{16}$ in. clearance between the two halves of the cotter on each side.

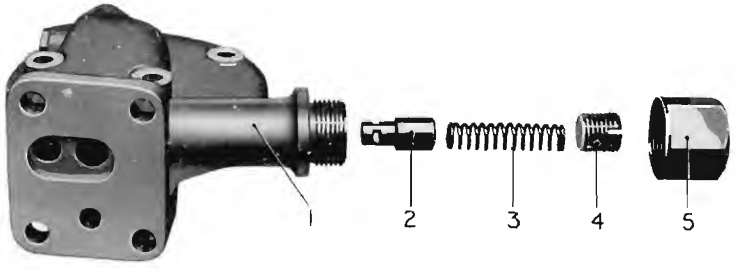


Fig. 6.
REMOVAL OF PRESSURE RELIEF VALVE.
1. Filter Head.
2. Relief Valve.
3. Relief-Valve Spring.
4. Adjusting Screw.
5. Relief-Valve Cap.

Adjusting Valve Clearances.

The adjusting screw (1), Fig. 5, secured in the end of the rocker by a clamp bolt (2) has a ball

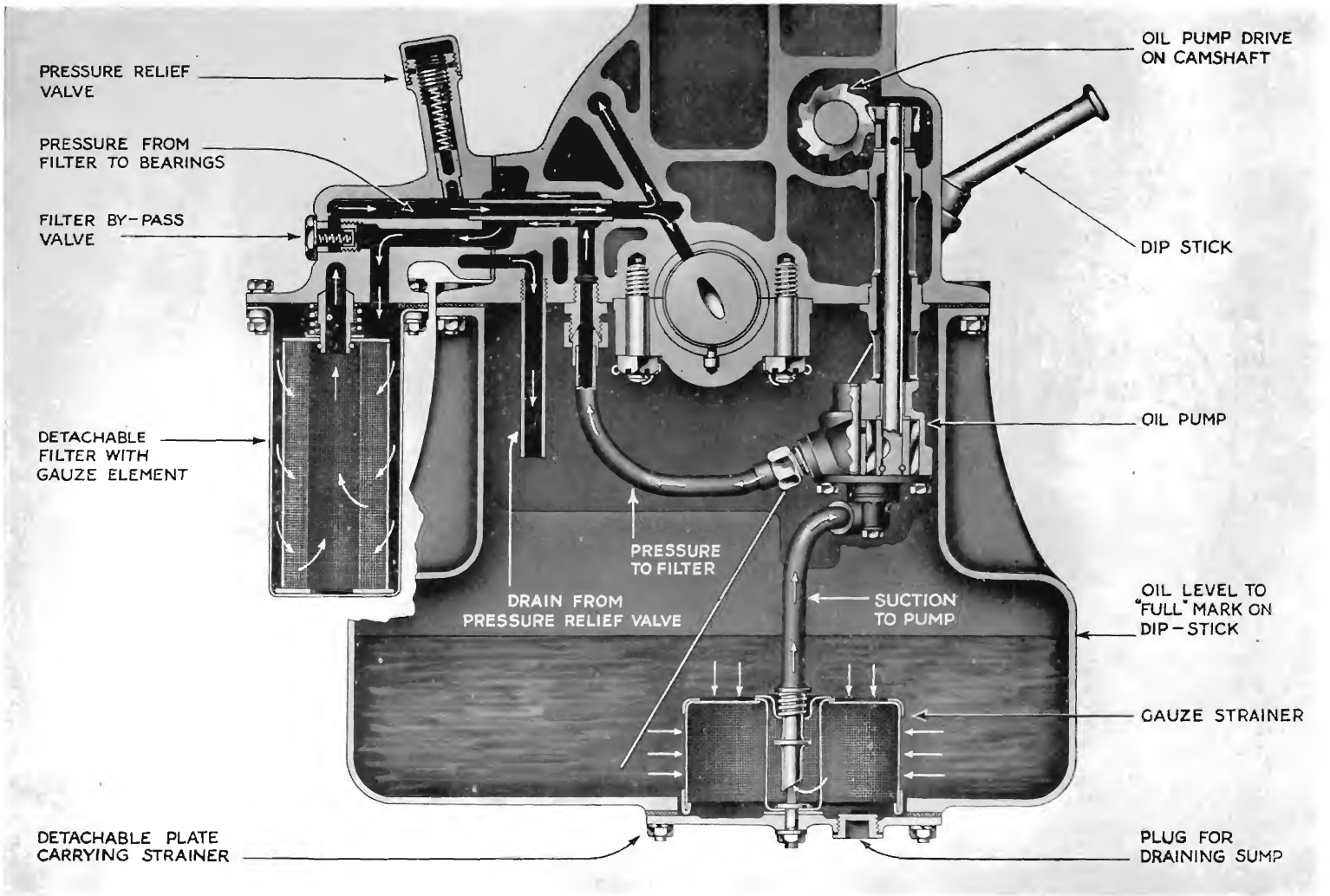
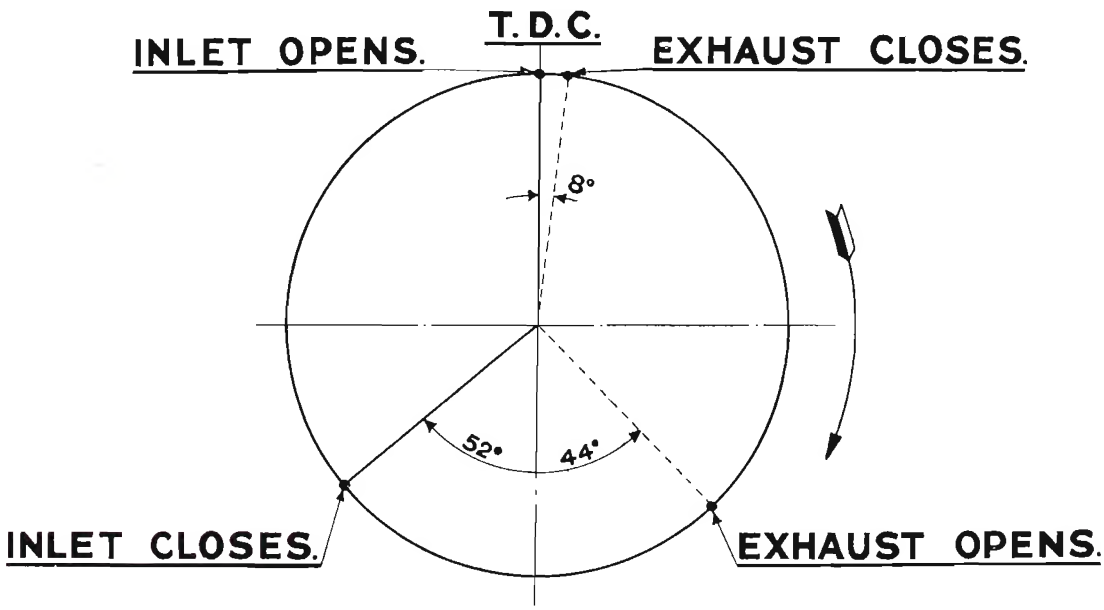


Fig. 7.
DIAGRAM SHOWING OIL CIRCULATION.

ENGINE



TIMING DIAGRAM ON CRANKSHAFT.

Fig. 8.
VALVE TIMING DIAGRAM.

formed at the lower end which fits into the cup end of the push rod. When adjusting clearances the tappet should be on the back of the cam and the engine should be turned until the valve is closed and the tappet approximately in this position. of the piston is on T.D.C. on the compression stroke, both valves on that cylinder will be in a suitable position for adjusting clearances.

Slacken the clamp bolt (2), Fig. 5, adjust the screw to give the necessary clearance, then lock the clamp bolt. The correct clearances are .020 in. for inlet and .020 in. for exhaust with engine cold.

When new exhaust valves have been fitted, it is necessary to check that the valve stem has a clearance of .0055 in. to .008 in. in the guide to avoid the possibility of a sticking exhaust valve.

Valve Timing.

The valve timing is as follows :—

Inlet opens	T.D.C.
Inlet closes	52° after B.D.C. or 6.36 in. on flywheel rim.
Exhaust opens	44° before B.D.C. or 5.38 in. on flywheel rim.
Exhaust closes	8° after T.D.C. or 0.98 in. on flywheel rim.

The timing diagram is shown in Fig. 8.

CYLINDER HEAD AND ROCKER GEAR

The standard cylinder head is a single iron casting with stellite-faced exhaust valve seats and special cast iron inlet seats screwed into position. On certain machines the cylinder head is of aluminium alloy, with screwed-in phosphor-bronze valve seats.

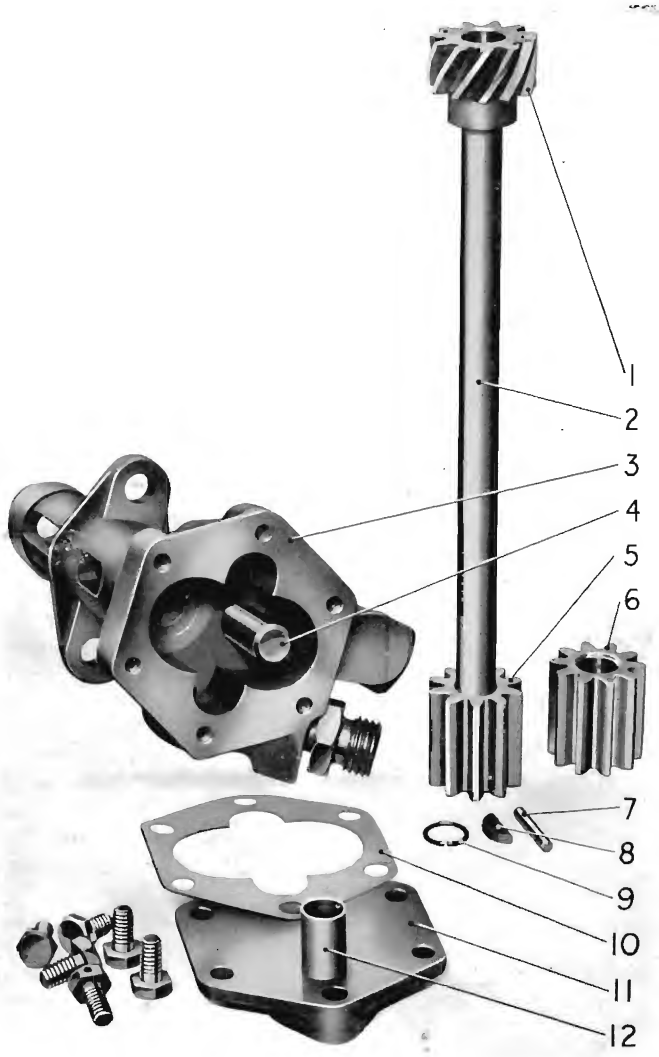


Fig. 9.

OIL PUMP ASSEMBLY.

1. Skew Gear.
2. Pump Spindle.
3. Oil Pump Body.
4. Idler Gear Spindle.
5. Driving Gear.
6. Idler Gear.
7. Taper Pin for Skew Gear.
8. Key for Driving Gear.
9. Circlip for Driving Gear.
10. Paper Joint.
11. Base Plate.
12. Stand Pipe.

The valve seats are renewable and it is recommended that cylinder heads requiring new inserts are sent to Leyland Service Depot for reconditioning.

The rocker shafts (12), Fig. 13, are each carried in three brackets (4) secured on studs which also locate the shafts endwise ; the shafts are hollow, the ends being sealed with welch washers. The rockers are bushed and are located on the shafts by springs (10). Pressure lubrication is provided from the main oil pump. A pipe from the oil pump passes into the block. The oil passes through an oilway in the block and head through a restrictor valve (9) and by way of the pipes (6) to the hollow rocker shafts. The shafts are thus filled with oil under pressure and holes are provided so that oil is supplied to each rocker bush.

Removal of Rocker Shafts.

The rocker shafts are removed as a unit by disconnecting the oil pipes at the unions (8) and taking off the holding down nuts (3). The rockers are then easily removed by releasing the circlips (11) located in the cup washers at each end of the shafts.

It is essential that the nuts (3) securing the rocker shafts are tightened hard and are kept tight. When replacing the oil pipes make sure that the fibre washers are fitted under the unions. The restrictor should be removed and cleaned.

Removal of Cylinder Head.

See under " Top Overhaul."

ENGINE

TOP OVERHAUL

Fig. 10.
OIL PUMP.

1. Delivery Pipe Union.
2. Setscrew.
3. Locking Wire.
4. Suction Pipe Union.

Provided that the valve clearances have been maintained correctly and suitable oil used, decarbonising should only be necessary after every 20,000 miles. It is recommended, however, that a top overhaul be given after the first 10,000 miles and then at intervals of 20,000 miles.

Removal of Cylinder Head.

Take off the cylinder head cover and detach the high tension leads from the plugs. Uncouple the carburetter controls and exhaust pipe, disconnect the front water connection and remove the fan belt. Remove the exhaust and inlet manifolds, disconnect the oil feed pipes and remove the rocker gear; then, when the holding down nuts have been removed, the cylinder head can be lifted. If the head is stuck do not attempt to prise it off, but tap lightly all round with a wooden mallet.

Place the head face downwards on the bench, compress the valve springs with the tool provided in the tool kit and remove the cotters. Clean the cylinder head and piston tops with a blunt tool or wire brush. Clean the sparking plugs and set the points to .020 in. for coil ignition or .016 in. for magneto ignition.

Valve Seats.

When stellite faced exhaust valve seats are fitted, they should not require grinding, but if this becomes necessary they cannot be touched with ordinary grinding compound. They must be faced up with a carborundum stone rotated at high speed in an electric drill. The stone must have a working face at the same angle, 30°, as the seating face, and must be provided with a long stem which fits snugly in the valve guide. If new guides are to be fitted, these should be in position before facing up the seats.

The valves should preferably be faced up in a valve-facing machine and then lightly ground in, using fine compound. If no facing machine is available, the valves can

be ground in on the seats using fine compound.

Inlet valve seats are of special cast iron and the valves can be ground in, in the usual manner. If the seat is badly pitted, it can be faced up with a seating cutter having a 30° face. Both inlet and exhaust valve seats are renewable.

In the case of aluminium heads with phosphor bronze seats, the valves can be ground in in the usual way.

Valve Seat Inserts.

In all cases the valve seat inserts are provided with splines formed inside to facilitate screwing them into position using a special tool. The splines are machined off after fitting the inserts.

To remove the inserts, unscrew with a hammer and chisel. In the case of stellite-faced inserts, chip off a piece of the stellite face with a narrow chisel to enable it to be unscrewed. Screw in the new inserts using the special tool and machine off the splines, at any rate in the inlet seats. The splines can be left on the exhaust seats if desired.

Valve Guides.

To fit new valve guides drive the old ones out from inside the head. Check that the new guides when driven in are right home. Exhaust valve guides should have a clearance of from .0055 in. to .008 in. on the valve stems.

Valve Springs.

It should be noted that the coils are closer together at one end than the other. When replacing springs it is important that the end with the least space between the coils be fitted next to the head.

Replacing Cylinder Head.

A new gasket should always be fitted unless the old one is in exceptionally good condition. Clean the faces of the head and block and carefully remove any rust or carbon from the holding down studs. If this foreign matter is left on the studs, as the head is lowered it will scrape some down and prevent a good bed being obtained between the head and block.

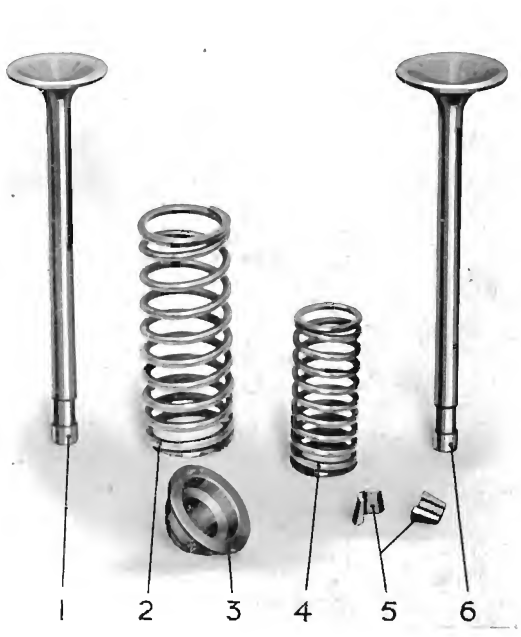


Fig. 11.
VALVES AND SPRINGS.

1. Exhaust Valve.
2. Valve Spring (outer).
3. Valve Spring Collar.
4. Valve Spring (inner).
5. Split Cotter.
6. Inlet Valve.

Lower the head and tighten all nuts lightly and evenly at first, then go round and tighten each nut a little at a time until all nuts are well tightened down. The nuts should always be tightened in some definite order, starting at the centre and working outwards in a widening circle as shown in Fig. 26. This applies particularly to aluminium heads.

Replace the rocker gear and lubrication pipes (see Fig. 13) taking care that the fibre washers are fitted at the unions. Set the valve clearances at .020 in. for both inlet and exhaust valves. Connect up the high tension cables, couple up the water connection, replace the manifolds, fitting new gaskets if necessary. Fit the carburetter and couple up the controls. Fill up the radiator,

ENGINE

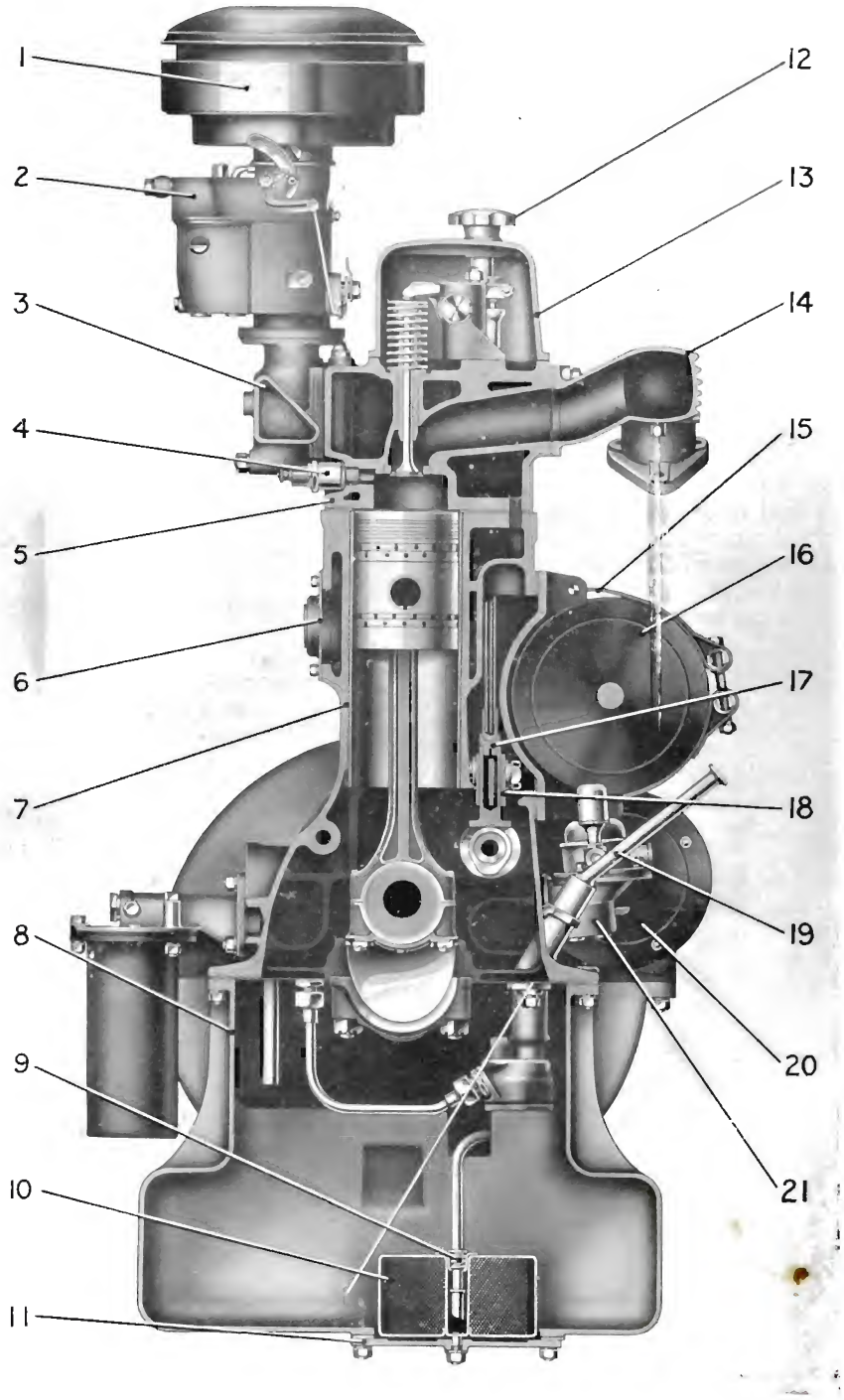


Fig. 12.

CROSS SECTION THROUGH ENGINE.

1. Air Cleaner.
2. Carburettor.
3. Inlet Manifold.
4. Sparking Plug.
5. Cylinder Head.
6. Water Jacket Cover
7. Cylinder Block.
8. Sump.
9. Spring on Suction Pipe.
10. Oil Sieve.
11. Cover Plate for Sump.
12. Valve Cover Nut.
13. Valve Gear Cover.
14. Exhaust Manifold.
15. Dynamo Strap
16. Dynamo.
17. Valve Tappet.
18. Valve Tappet Bracket.
19. Dip Stick.
20. Starter Motor.
21. Petrol Feed Pump.

start the engine and run until warmed up. Then allow the engine to cool down and check the valve clearances with the engine cold. Check the rocker shaft oil supply.

CAMSHAFT

The camshaft is carried in four bearings, three of which are located in the engine casing, the fourth, a white metal bush, is secured to the front end by two studs. The skew gear for the oil pump drive and the eccentric for operating the petrol feed pump are formed integrally with the camshaft.

Removal of Camshaft.

To withdraw the camshaft, remove the radiator, drop the sump and remove the oil pump. Detach the petrol feed pump by removing the two nuts securing it to the crankcase and remove the tappets in their brackets by taking out the setscrews securing them to the block. Take off the timing case

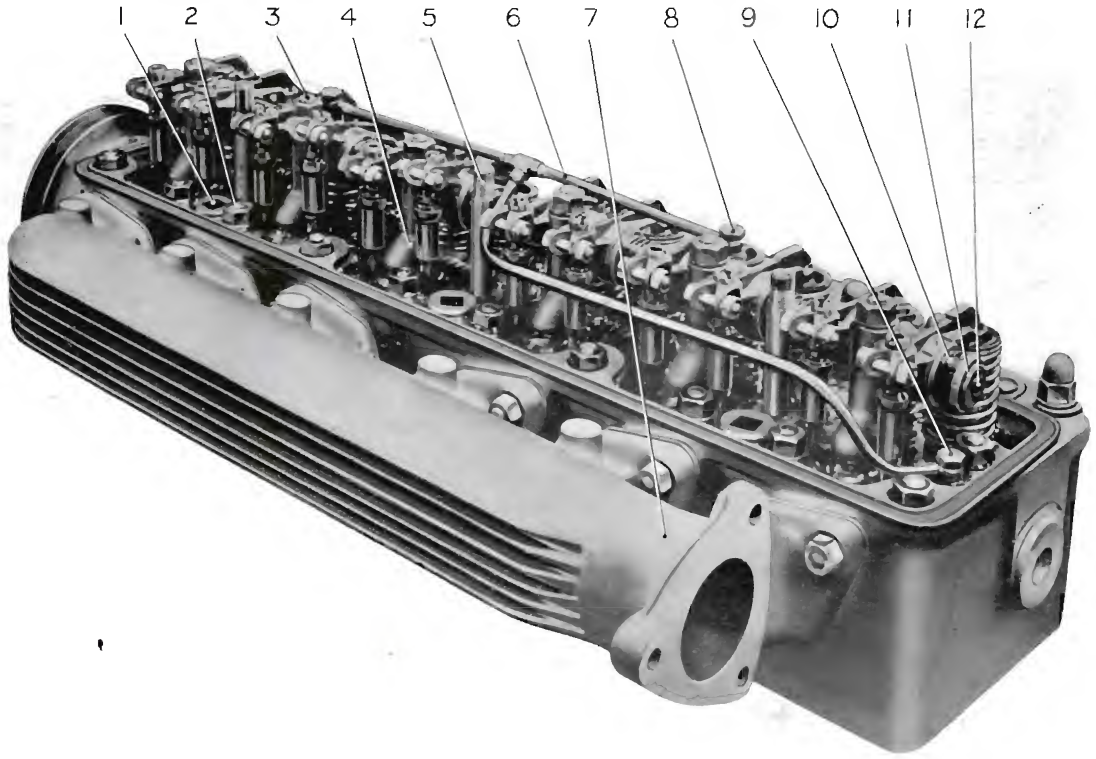


Fig. 13.
CYLINDER HEAD AND ROCKER GEAR.

1. Plug for Cylinder Head.
2. Holding Down Nut.
3. Nut for Rocker Shaft Bracket.
4. Rocker Shaft Bracket.
5. Stud for Valve Cover.
6. Oil Supply Pipe for Rocker Gear.
7. Exhaust Manifold.
8. Union for Oil Pipe.
9. Restrictor Valve.
10. Rocker Shaft Spring.
11. Circlips.
12. Rocker Shaft.

ENGINE

Fig. 14.
SECTION THROUGH ENGINE.

1. Rocker Shaft Stud.
2. Water Pump.
3. Centre Main Bearing (top half).
4. Centre Main Bearing (bottom half).
5. Centre Main Bearing Cap.
6. Intermediate Main Bearing (top half).
7. Intermediate Main Bearing (bottom half).
8. Intermediate Main Bearing Cap.
9. Front Main Bearing (top half).
10. Front Main Bearing (bottom half).
11. Dowel for Main Bearing.
12. Front Main Bearing Cap.
13. Oil Seal on Front of Crankshaft.
14. Crankshaft Damper.
15. Timing Case-Cover.
16. Restrictor Valve.
17. Inlet Valve Guide.
18. Inlet Valve Seat.
19. Exhaust Valve Guide.
20. Exhaust Valve Seat.
21. Oil Pipe to Cylinder Head.
22. Valve Tappet Cover.
23. Aluminium Plug.
24. Camshaft.
25. Rear Main Bearing (top half).
26. Rear Main Bearing (bottom half).
27. Rear Main Bearing Cap.
28. Clutch Insert.
29. Flywheel.
30. Starter Ring.
31. Crankshaft.

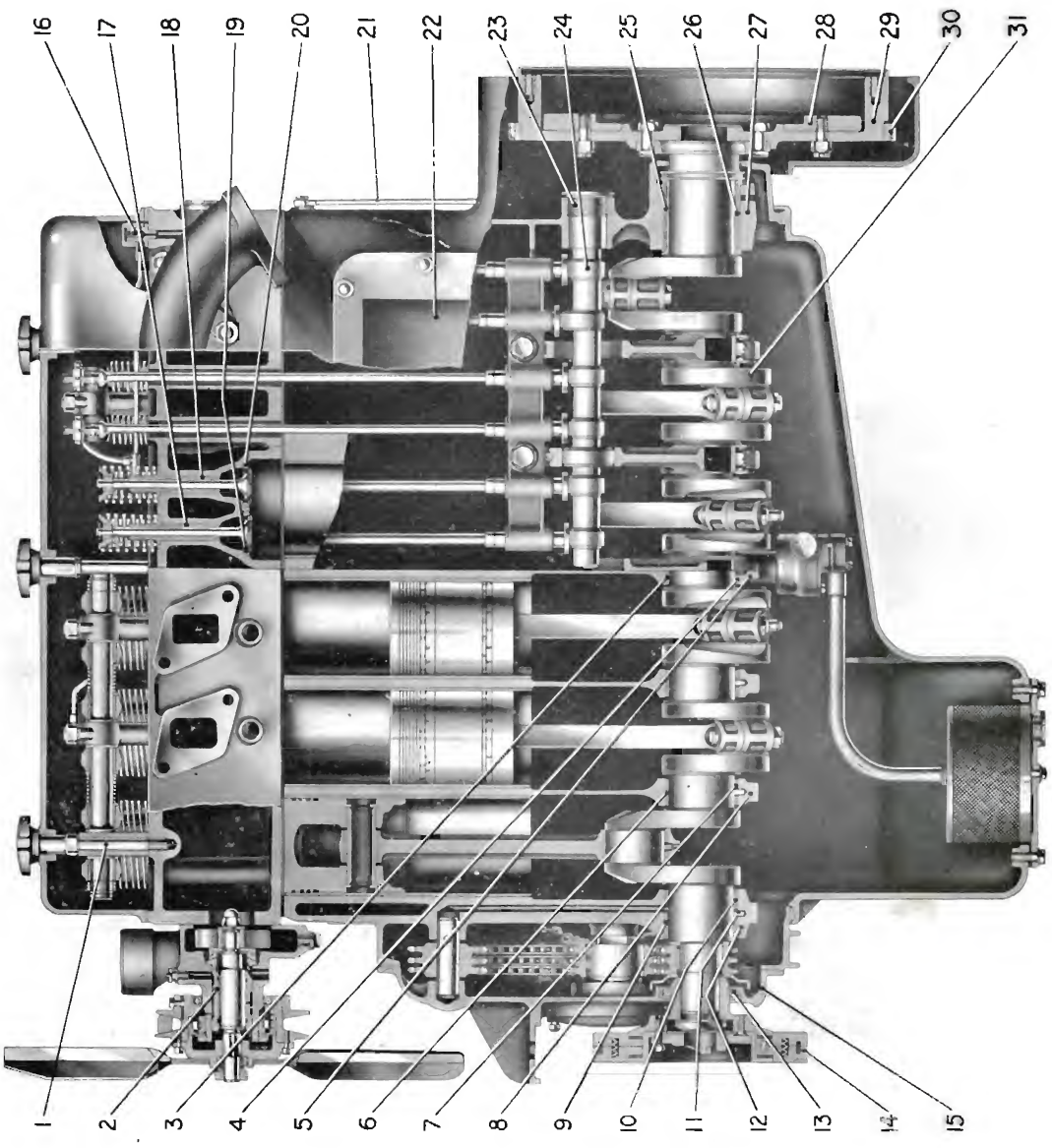


Fig. 15.
CAMSHAFT

cover (see " Timing Gear ") and remove the timing chain by taking out a link (see " Removal of Timing Chain "). The two screws at (2), Fig. 17, securing the thrust washer, can be removed through the holes in the camshaft sprocket and the camshaft withdrawn. The sprocket is keyed on the camshaft (two keyways giving a ½ tooth variation, being provided to assist in timing when a new sprocket is fitted) and secured by a nut and tab washer. It is not necessary to remove the aluminium plug behind the camshaft. If the thrust washer is badly scored or worn a new one should be fitted ; end play on the camshaft with a new thrust washer should be from .0025 in. to .0045 in.

Replacing Camshaft.

Feed in the camshaft, tighten up the thrust washer and replace the tappets in their brackets. Rivet up the timing chain before fitting the idle sprocket at (1), Fig. 17, and chain tensioner (see " Replacing Timing Chain ").

Timing the Camshaft.

Set the valve clearances on No. 1 cylinder to .020 in. both inlet and exhaust, with the tappets on the backs of the cams. Insert a piece of thin sheet metal or stout paper at (4), Fig. 17, to hold the chain clear of the camshaft sprocket.

Set the engine with No. 1 and 6 mark on the flywheel in line with the mark on the housing, that is with No. 1 piston on T.D.C. Turn the camshaft in direction of rotation (anticlockwise looking at the front of the engine) until No. 1 inlet valve is about to leave its seat, then remove the sheet metal and mesh up the timing chain without slack between the crankshaft and camshaft sprockets.

If a new sprocket has been fitted and there is slight slack between the sprockets when the chain is meshed up, the timing is probably a half tooth out and this can be remedied by fitting the sprocket on the other keyway. The idle sprocket and tensioner can now be replaced, keeping the eccentric at its minimum radius while sliding it on the spindle.

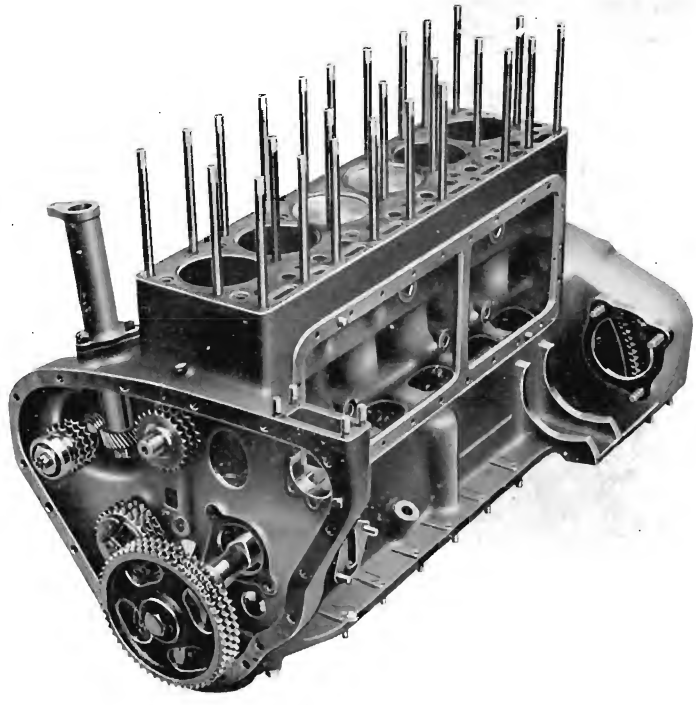


Fig. 16.
REMOVAL OF CAMSHAFT.

ENGINE

TIMING GEAR

The timing gear is situated at the front of the engine, the camshaft and auxiliaries being driven by means of a triplex chain. The chain tension is kept constant by means of an automatic tensioner (9), Fig. 18, so that no adjustment is required throughout the useful life of the chain.

The driving sprocket (10) is keyed on the crankshaft and secured by a nut which also secures the crankshaft damper. The auxiliaries are driven through sprockets (2) and (7) and the distributor through skew gears (4). The idle sprocket (5) avoids a long run of chain and further envelops the auxiliary sprockets.

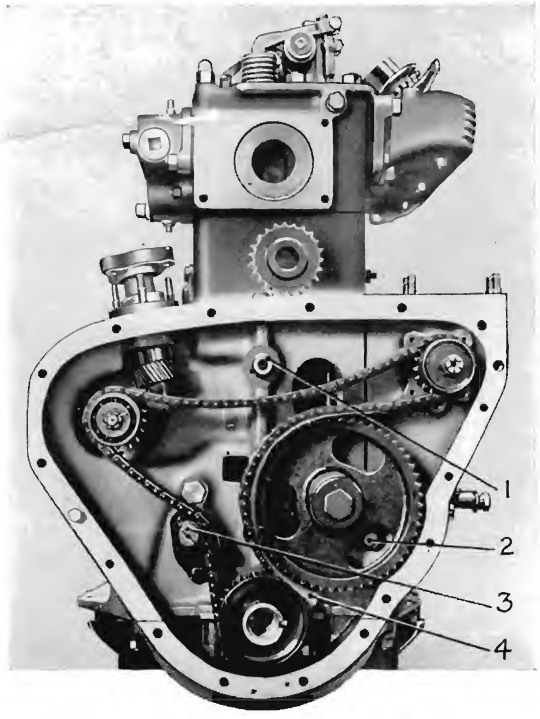


Fig. 17.
TIMING THE CAMSHAFT.
1. Idler Gear Spindle.
2. Setscrew for Camshaft Bearing.
3. Tensioner Spindle.
4. Sheet Metal Strip.

Timing Chain.

The new chain is of such length that the automatic tensioner is at its minimum radius ; when the tensioner has reached its maximum radius the chain should be renewed.

The chain consists of 126 pitches $\frac{3}{8}$ in. pitch, the total length being $47\frac{1}{4}$ in. when new and the maximum stretch allowable due to wear is one and a half per cent. of its original length. If when laid on a flat surface with the ends pulled as far apart as possible, the length exceeds $47\frac{5}{8}$ in. excluding the link removed, a new chain should be fitted.

Removal of Timing Chain.

To remove or inspect the timing chain the radiator must be detached, the crankshaft damper removed (see " Crankshaft Damper ") and the fan pulley removed. If the engine is in the chassis it will be necessary to support it on packings before removing the timing case cover, as the front engine foot is made integral with the cover. Remove the holding down bolts and the setscrews securing the cover, then remove the cover.

The chain can be removed by taking out a link, using rivet extractor K.2450. If no extractor is available slack off the tensioner and draw the eccentric off the spindle, remove the idle sprocket and draw off the camshaft sprocket.

Replacing Timing Chain.

Thread in the chain before fitting the idle sprocket and tensioner and rivet up. If a link has not been removed the camshaft sprocket must be fitted after the chain. Check up the valve timing (see " Timing Camshaft ") and distributor or magneto timing. Fit the idle sprocket, mesh the tensioner sprocket with the chain and slide the eccentric on the spindle. Adjust the tensioner as outlined under " Adjustment of Tensioner."

Sprocket Shafts.

The crankshaft sprocket is keyed on the shaft and can be withdrawn, using an extractor. The sprocket (5), Fig. 18, runs on a pin located in the block by a peg and supported in the timing case cover. The dynamo sprocket (7) and ignition sprocket (2) are keyed on their shafts which run in ball bearings. The back bearing is pressed on the shaft against a shoulder, the sprocket is keyed and front bearing pressed on, the whole being locked by a nut and split pin. Oil flingers are fitted behind the back bearings and shims are fitted for chain alignment purposes.

Removal of Sprocket Shafts.

To remove the auxiliary sprocket shafts, unscrew the nuts and draw off the front bearings. Remove the back covers and tap the shafts through the sprockets, taking care not to damage the threads.

Replacing Sprocket Shafts.

To replace the shafts reverse the removal operation, taking great care to see that any shims are replaced in their original positions. Check the sprockets for alignment with a straight-edge after assembly.

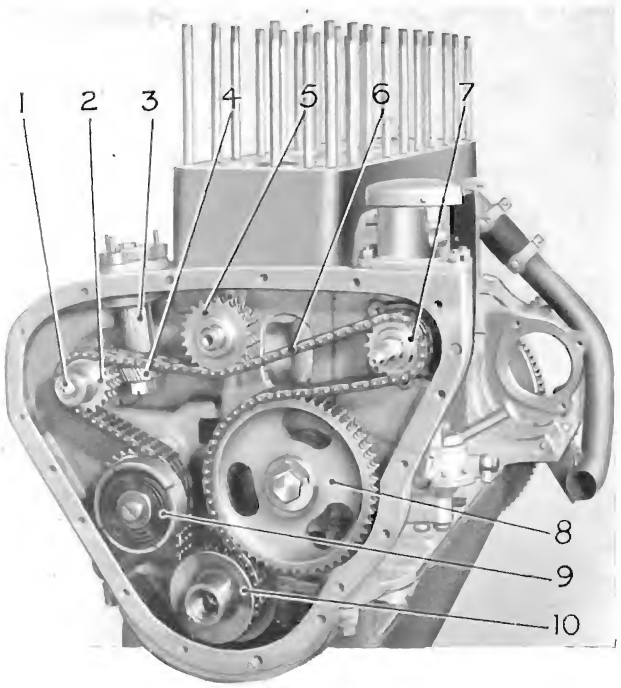


Fig. 18.
TIMING GEAR.

1. Nut for Distributor Drive Sprocket.
2. Distributor Drive Sprocket.
3. Distributor Drive Sleeve.
4. Distributor Drive Gear.
5. Idle Sprocket.
6. Timing Chain.
7. Dynamo Drive Socket.
8. Camshaft Sprocket.
9. Chain Tensioner.
10. Crankshaft Sprocket.

Distributor Drive.

The distributor drive consists of a spindle housed in a sleeve (3), Fig. 18, the skew gear (4) being secured by a nut and split pin. The other skew gear is carried on the sprocket shaft. When a magneto is fitted, the drive is taken from the same sprocket shaft through a vernier coupling.

Automatic Chain Tensioner.

This consists of an idle sprocket (5), Fig. 20, mounted on an eccentric sleeve (4) carried on a spindle (10) located in the engine casing by a peg and secured by a large nut and washer inside the block. It is further secured by a D-shaped locking plate bolted to the block. The spindle should not require removal, but to gain access to the nut the sump must be dropped. The thread must be burred over to prevent the nut from working loose.

The total adjustment of the tensioner is determined by a peg in the spindle which registers in a slot in the eccentric sleeve (4) and prevents it from rotating past its maximum throw position. A ratchet cage (2) is housed in the eccentric and located by a peg, the pawl carrier (3) locating in the splines on the spindle (10). A tab on the inner end of the clock type spring (1) locates in a slot in the end of the spindle, the outer end of the spring being hooked in the appropriate one of a number of slots in the eccentric rim. The assembly is secured by a washer and split pin.

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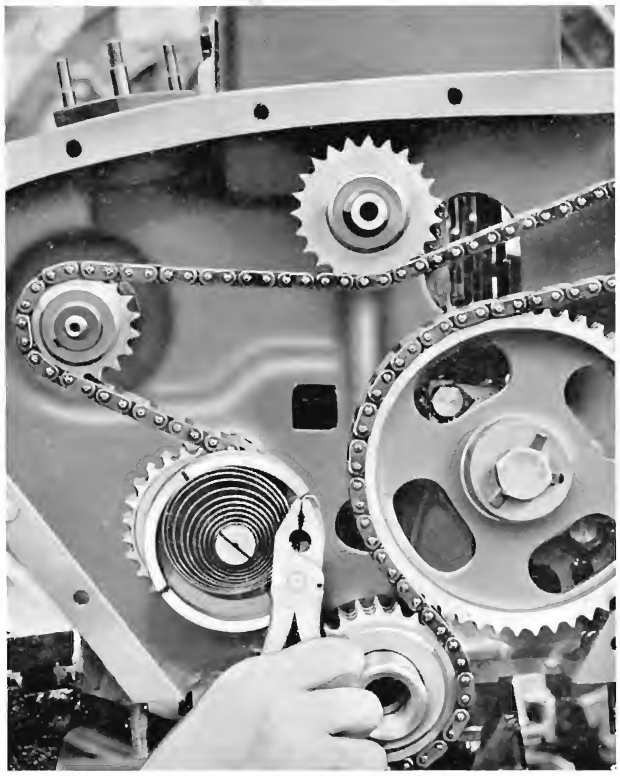


Fig. 19.
ADJUSTMENT OF TENSIONER.

As the chain stretches due to wear, the spring rotates the eccentric in a clockwise direction and the ratchet engages with a pawl in the pawl carrier, thus preventing rotation in an anticlockwise direction, the play being limited to that between one pawl and the next. When the chain is worn out the eccentric has reached its maximum throw position and a new chain should be fitted.

To release the tensioner, take out the split pin and draw the spring and ratchet forward clear of the splines. The tensioner can then be rotated in an anticlockwise direction.

Adjustment of Tensioner.

The tensioner is accessible through a plate on the front of the timing case. To reset the tensioner after refitting, take out the spring and press the eccentric on the spindle, turning the pawl carrier until it will go on the splines.

Replace the spring with the tab in the slot and with a pair of pliers give the spring 3½ turns and engage the hook in the next slot, as shown in Fig. 19. **Take care that the spring is refitted so that its action is in a clockwise direction looking at the front of the engine.**

CRANKSHAFT DAMPER

On certain models a friction type damper is fitted on the front end of the crankshaft as shown in Fig. 23. The damper consists of two loose plates (4), Fig. 21, and two rings of friction material (5) held together between two flanges (1) and (6); the necessary pressure is supplied by the coil springs (3). The unit is keyed on the crankshaft, is a press fit and is secured by a large setscrew at (2), Fig. 23, and locking washer.

Removal of Damper.

To remove the damper take out the four setscrews (3), Fig. 23, securing the starting dog (1) to the inner flange and remove the dog. Release the locking washer and remove the setscrew; the unit can then be drawn off using a suitable extractor K.9034. To dismantle the damper take out the two setscrews holding the flanges together. If there is any oil on the friction faces they should be thoroughly washed in petrol. Check that the rubber dirt excluding ring (2), Fig. 21, is in good condition. When replacing, press the damper on the shaft and lock with the setscrew and tab washer.

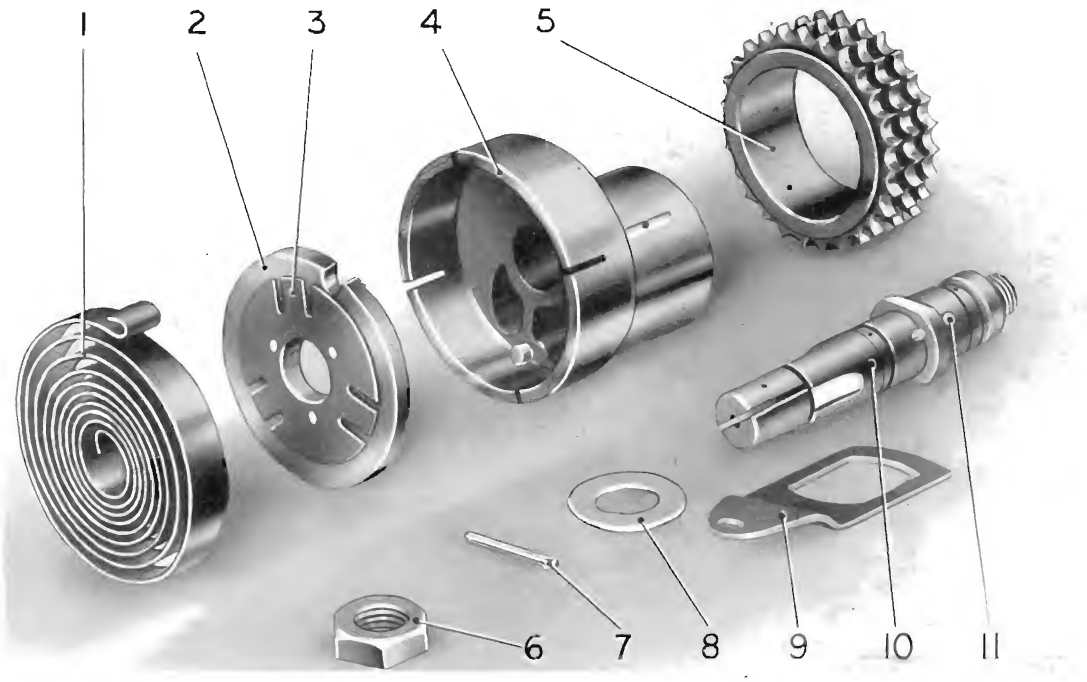


Fig. 20.
CHAIN TENSIONER ASSEMBLY.

1. Spring for Tensioner.
2. Ratchet Cage.
3. Pawl Carrier.
4. Eccentric Sleeve.
5. Sprocket for Tensioner.
6. Locking Nut for Tensioner Spindle.
7. Split Pin.
8. Retaining Washer.
9. Locking Washer for Spindle.
10. Tensioner Spindle.
11. Locating Peg for Spindle.

MAIN BEARINGS

The crankshaft is carried in seven main bearings, shown in Fig. 25, the journals being $2\frac{1}{2}$ in. diameter. The main bearings are steel shells, white metal lined. End location of the crankshaft is by means of the rear main only which should have .004 in. end clearance. The shaft has freedom for movement in the other main bearings.

The bearings are located in the caps and crankcase by means of dowel pins (2), Fig. 22. The rear main is provided with a trough (7) and a drain hole (5) to allow excess oil to return to the sump and prevent leakage at this point. The bearings and caps are stamped in numerical order starting from the front of the engine and should be replaced in this order with the numbers to the tappet side of the engine.

Fitting Main Bearings.

The bearings are not adjustable as no shims are fitted and the caps should not be filed, as this will necessitate new ones when the crankshaft is reground.

If there is excessive play in the bearings the crankshaft should be reground. New bearings in undersize steps of .010 in. are available for use with reground crankshafts.

When fitting new bearings the shells must be bedded down to the crankcase and caps, the top halves to be checked with a straight edge before bedding in the shaft. Little or no scraping should be required, but the crankshaft should be checked for marking

ENGINE

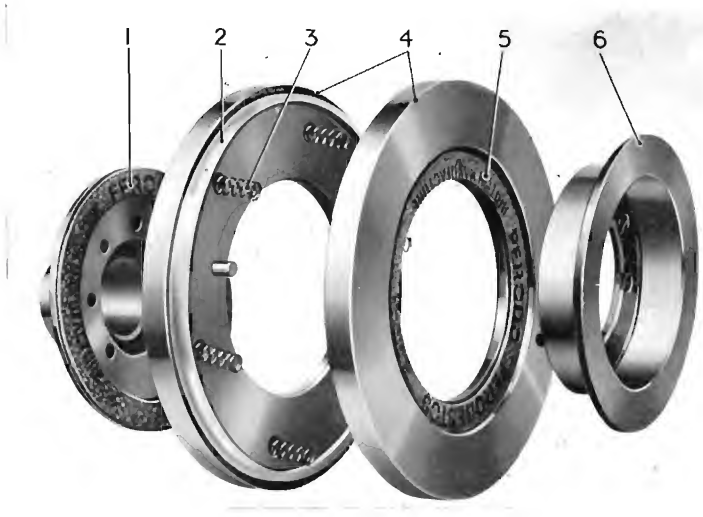


Fig. 21.
CRANKSHAFT DAMPER.

1. Damper Flange (rear).
2. Rubber Dirt Excluding Ring.
3. Damper Spring.
4. Camper Plate.
5. Friction Liner.
6. Damper Flange (front).

with the caps tight. If a full marking is not obtained the bearings must be scraped to a fit, starting at the centre main, then front and rear mains and finally the intermediate bearings. **On no account must a nut be slacked back or a bearing hammered if too tight or to bring the pin holes into line.** The nuts must be filed to bring the holes into line, care being taken to keep the faces true.

See that the dowel pins are well below the surface of the white metal. Bearings should have a clearance of .001 in. to .002 in. on the shaft and it should be possible to turn the shaft with a small bar when all caps are tight up without oil.

CONNECTING RODS AND PISTONS

The connecting rods are of alloy steel, the big end bearings are steel shells, white-metal lined and the small ends are bronze bushed. The gudgeon pins are fully floating, and are located in the pistons by circlips. Pistons, connecting rods and caps are all numbered in numerical order from the front of the engine, and should be fitted in the correct order with all numbers to the tappet side of the engine.

Gudgeon Pins.

The gudgeon pins should be a tight push fit in the pistons and an easy push fit in the small end bushes. Special pliers are available for removing the circlips.

When replacing gudgeon

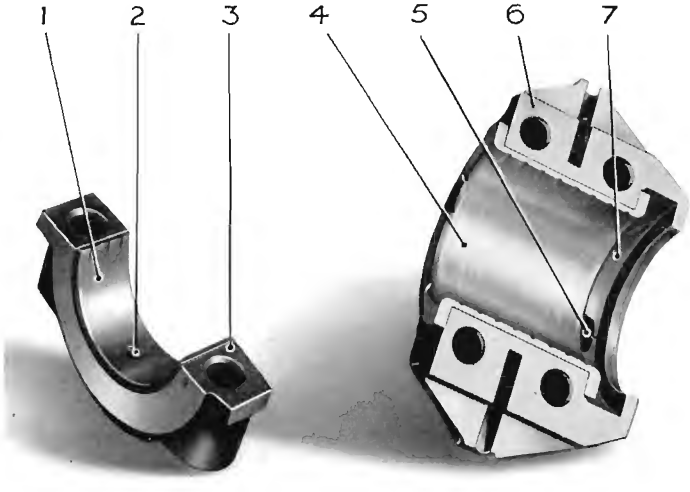


Fig. 22.
MAIN BEARINGS.

1. Main Bearing (intermediate).
2. Dowel for Main Bearing.
3. Main Bearing Cap (intermediate).
4. Main Bearing (rear).
5. Drain Hole in Rear Bearing Cap.
6. Main Bearing Cap (rear).
7. Oil Trough in Rear Bearing Cap.

pins, the piston bosses must on no account be reamed out if the pins are tight. Dipping the pistons in boiling water will facilitate inserting the pins.

Big End Bearings.

Do not file the connecting rods and caps in order to take up wear on the big ends.

The crank pins should be reground when .005 in. to .006 in. oval and undersize bearings in steps of .010 in. are available to suit reground pins; three regrinds are permissible.

When fitting new bearings they should be scraped, if necessary, to show at least a 75 per cent. bed with .001 in. to .002 in. clearance on the pins and end play of .002 in. to .003 in. The bearings should rotate freely on the pins without oil when the nuts are tightened. **Bolts must be dead tight, on no account must they be slackened back if a bearing is too tight. If the pin holes are not in line, the nuts must be filed, care being taken to keep the faces true.**

Fig. 23.
CRANKSHAFT.
1. Starting Dog. 2. Damper Retaining Setscrew. 3. Starting Dog Setscrew.

Removal of Connecting Rods and Pistons.

The connecting rods and pistons can be removed after lifting the cylinder head and removing the sump. Take off the big end caps and the connecting rods can be drawn up through the bore.

Pistons.

The pistons (shown in Fig. 23) are aluminium alloy and are provided with three compression rings and one scraper ring. They are oval and taper ground, ample clearance being provided around the gudgeon pin bosses. Pistons are numbered and should be replaced in their correct cylinders with the numbers to the tappet side of the engine.

The normal clearance is .010 in. on the ring lands and .004 in. on the skirt.

Piston Rings.

The three compression rings are fitted at the top of the piston, the slotted type scraper ring is fitted in the bottom groove. If up and down play exceeds .006 in. and the gap .020 in. new rings should be fitted. When fitting new rings they should have .001 in. to .002 in. play in the grooves and a gap of .010 in. for the top ring and .008 in. for the lower rings. Test the gap half-way up the bore with the rings squared up on top of a piston.

ENGINE

CYLINDER BLOCK

The combined cylinder block and crankcase casting forms an exceptionally rigid unit. Renewable centrifugally cast iron liners are fitted in the cylinder bores and these can in emergencies be removed and replaced without removing the engine from the chassis.

Cylinder Liners.

Service liners are available in two forms, finished ground on the outside only and finished ground both outside and in the bore. The former are intended for use at overhaul when a complete set of liners is to be fitted. The latter are primarily for fitting odd liners, with the engine in the chassis, in the event of damage to a single bore. A special tool has been developed to facilitate removing and fitting these liners.

New liners should be fitted when the bore is .015 in. oversize at the top or .006 in. half-way down.

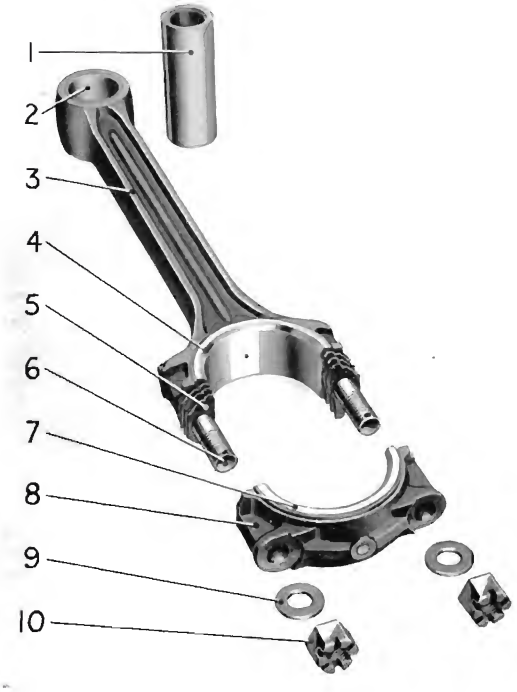


Fig. 24.
CONNECTING ROD.

1. Gudgeon Pin.
2. Gudgeon Pin Bush.
3. Connecting Rod.
4. Big-End Bearing (top half).
5. .002 in. shim. (Not fitted).
6. Big-End Bolt.
7. Big-End Bearing (bottom half).
8. Connecting Rod Cap.
9. Washer for Big-End Bolt.
10. Big-End Nut.

Fitting Liners.

To remove worn liners from the block a press will be required ; a hand press is quite sufficient. The block should be arranged so that the liner has a clear passage as it leaves the bore. A mandrel should be used which fits the liner bore and is provided with a shoulder to rest on the edge of the liner. The liners should be pressed out from the bottom and once started should press out quite readily.

Before fitting new liners, thoroughly clean out the cylinder bores and the outside of the liners. Coat the outside of the liner with one of the proprietary non-rust preparations sold for this purpose. This will greatly facilitate pressing out the liners on subsequent occasions.

Arrange the liner to enter the bore from the top, taking care that it is centralised with the bore. Place the mandrel on top of the liner and press home.

After pressing in, the bores must be ground to size + .001 in. to — .000 in.

When fitting finished ground liners, it is essential that the bores are measured, after fitting, to ensure that they are round and that there are the correct clearances between piston and liner. Any distortion of the cylinder bore will be transferred to the liners and may cause a piston seizure. If the clearances are incorrect or the liner is distorted, grinding or honing is necessary.

A special tool is available for removing and fitting these liners with the engine in the chassis. Remove the cylinder head and

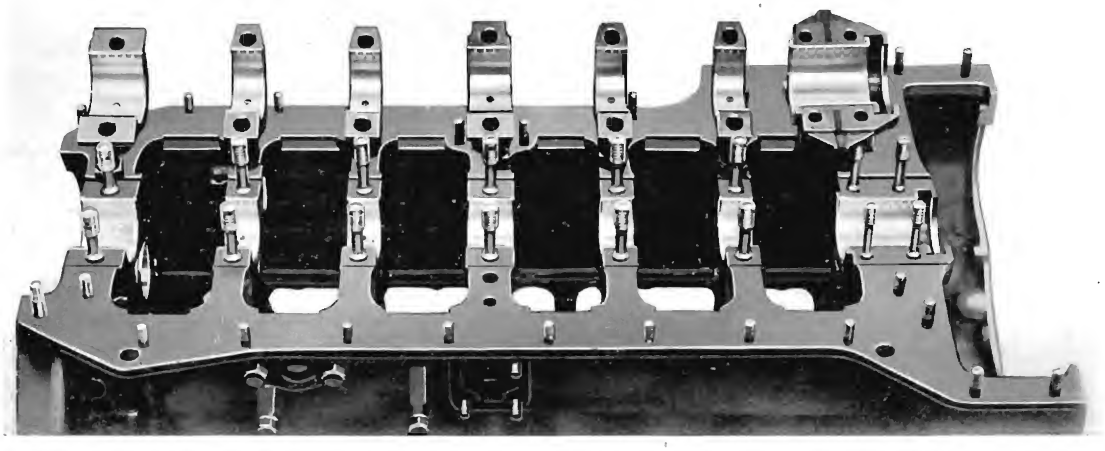


Fig. 25.
MAIN BEARINGS.

sump and withdraw the connecting rods and pistons. Fit the mandrel under the liner and hold in position with the short bar, which can be threaded in from below. Screw the short threaded end of the withdrawal rod into the mandrel from above. Place the withdrawal sleeve over the cylinder, fit the thrust bearing and screw on the large nut to withdraw the liner.

Clean and smear the liners as already outlined. Fit the clamping beam under the crankcase and screw in the short thread of the withdrawal rod. Insert the liner in the bore, fit the thrust bearing and nut and screw the liner home. **It is essential to check that the liner and tool are centralised before starting to press in the liner.**

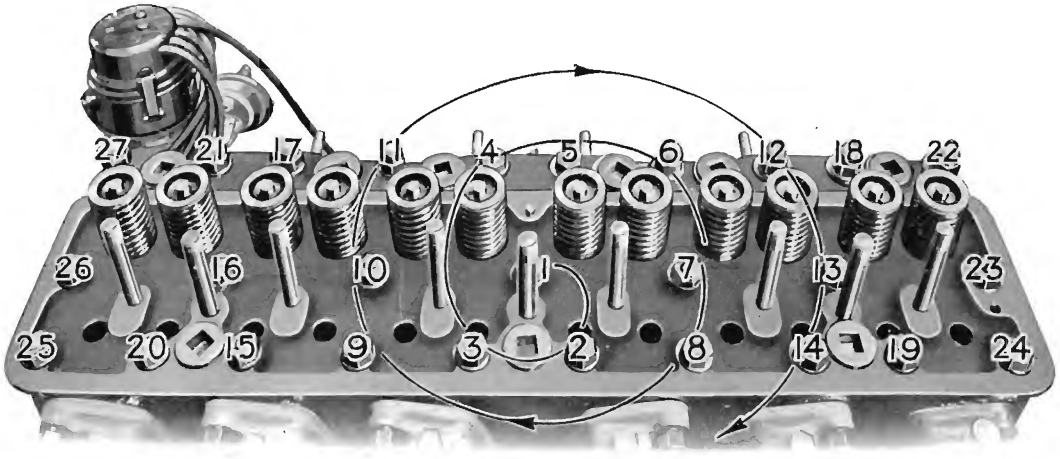


Fig. 26.
CORRECT METHOD OF TIGHTENING CYLINDER HEAD NUTS.

ENGINE

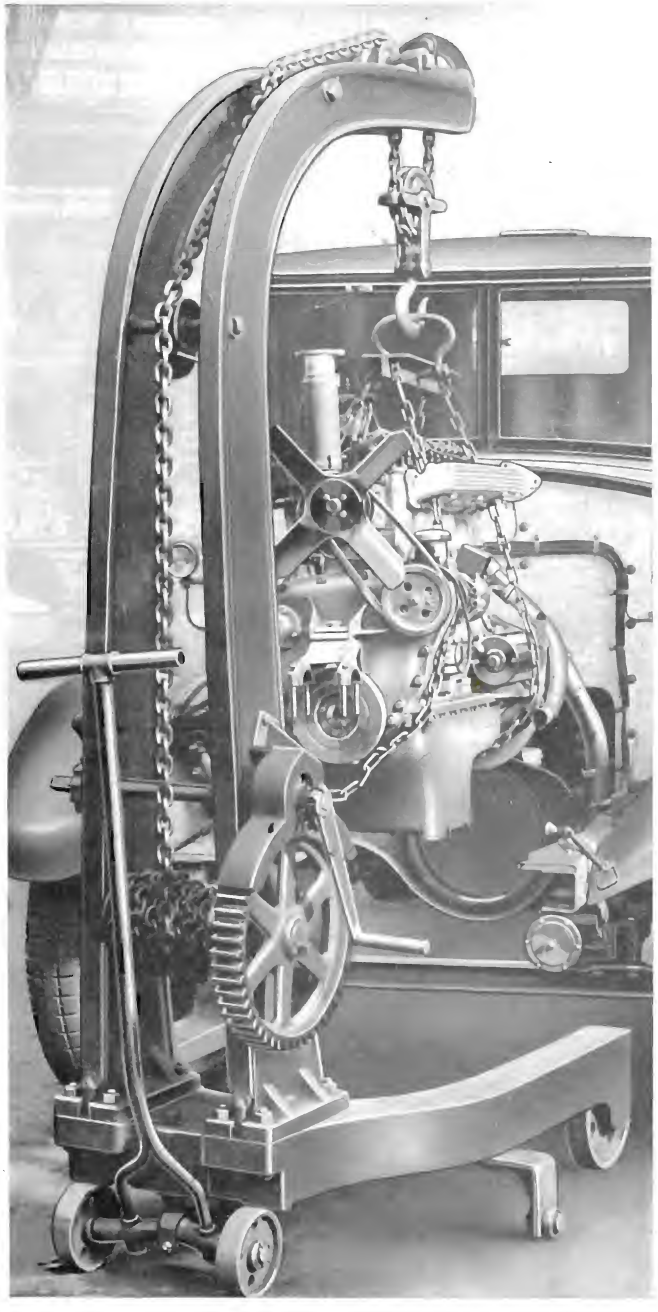


Fig. 27.
REMOVAL OF ENGINE (BONNETED TYPE).

FLYWHEEL AND STARTER RING

The flywheel is a steel stamping with the starter ring shrunk on and an insert for the clutch face; studs are screwed into this insert and the nuts are split pinned behind the flywheel. The flywheel bolts are of alloy steel and are fitted in reamed holes which are unevenly pitched, so that the flywheel cannot be replaced with the timing marks in the wrong position. The clutch shaft spigot bearing is retained by a small cover and three setscrews which are wired together.

If the starter ring is worn the flywheel should be removed and exchanged for a service flywheel with ring at a Leyland Service Depot. Should this not be practicable, remove the flywheel and split the starter ring with a cold set, do not use an oxy flame. Heat the new ring in an oil bath to a temperature of approximately 175° C., 350° F., and transfer it quickly to the flywheel ensuring that it is right down on the spigot and the chamfered side of the teeth is to the engine.

To remove the flywheel, detach the gearbox and withdraw the clutch, take off the starter motor after disconnecting the cables from the battery. Remove the six bolts securing the flywheel and it can be withdrawn from the crankshaft. When replacing, check that the bolts are a tight fit in the holes, tighten them solid and rivet over. Pack the spigot bearing with high melting point grease.

The clutch insert and bearing should be removed.

FAN AND WATER PUMP

The fan and water pump are secured to the cylinder head and are driven by an endless belt. The belt can be tightened by slacking the locking screw (8), Fig. 28, in the small rear flange (7) and screwing up the large flange (6). Do not overtighten. There should be 4 in. between the runs half-way down when the thumb is pressed on one of them. The driving pulley is keyed on the dynamo sprocket shaft.

Whenever the radiator and water system is drained in cold weather, the tap in the base of the pump body should be opened, otherwise a pocket of water will be left in the pump.

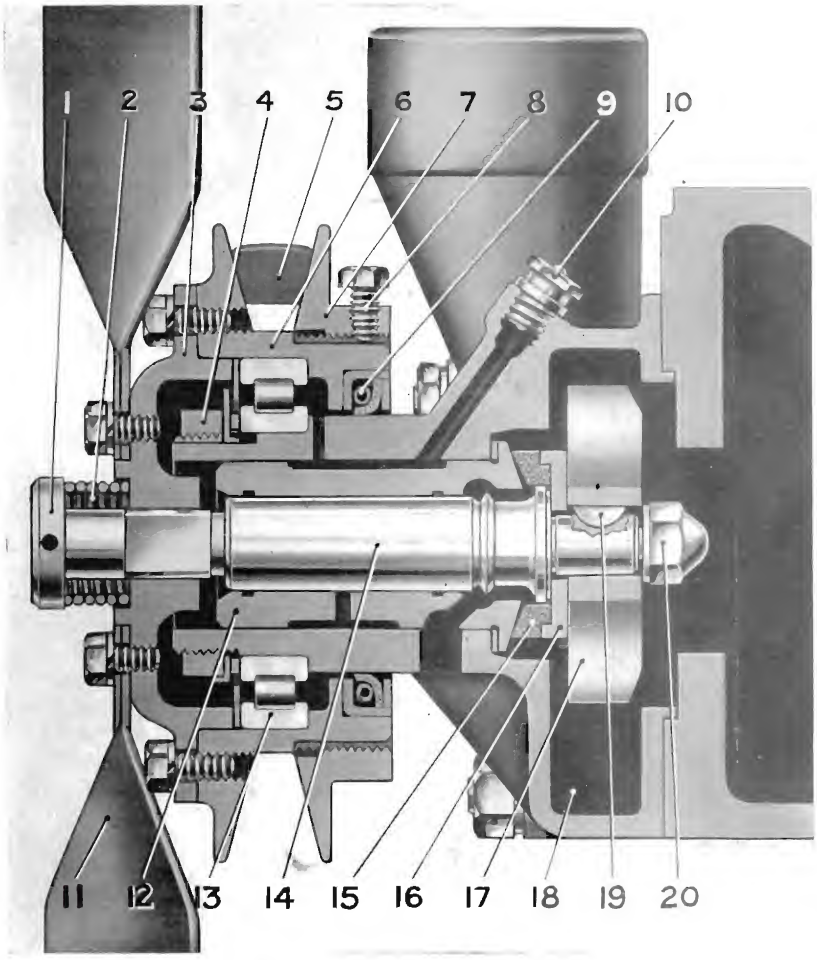


Fig. 28.

FAN AND WATER PUMP.

1. Collar for Pump Spindle.
2. Spring for Pump Spindle.
3. Cover for Bearing Housing.
4. Lock Nut for Roller Bearing.
5. Driving Belt.
6. Driving Flange (large).
7. Driving Flange (small).
8. Locking Screw for Driving Flange.
9. Oil Seal.
10. Nipple for Bearing.
11. Fan.
12. Phosphor Bronze Bush.
13. Roller Bearing.
14. Pump Spindle.
15. Carbon Gland.
16. Housing for Carbon
17. Impeller.
18. Water Pump Casing.
19. Key for Impeller.
20. Nut for Impeller.

The water pump is of simple construction, with a self-adjusting carbon gland. The spindle is spring loaded and runs in a long phosphor bronze bush (12), the carbon seal being held against it by the spring pressure.

To dismantle the pump remove the unit from the engine by taking off the four nuts securing it to the head and take off the fan by removing the four screws.

Punch out the pin and draw off the collar (1) and spring, the spindle complete with impeller, and carbon seal can then be withdrawn from the rear.

No attention should be required by the carbon seal, but if at overhaul a new one is to be fitted, take off the nut and draw the impeller and seal housing off the spindle. Heat the housing in an oil bath until the carbon

ENGINE

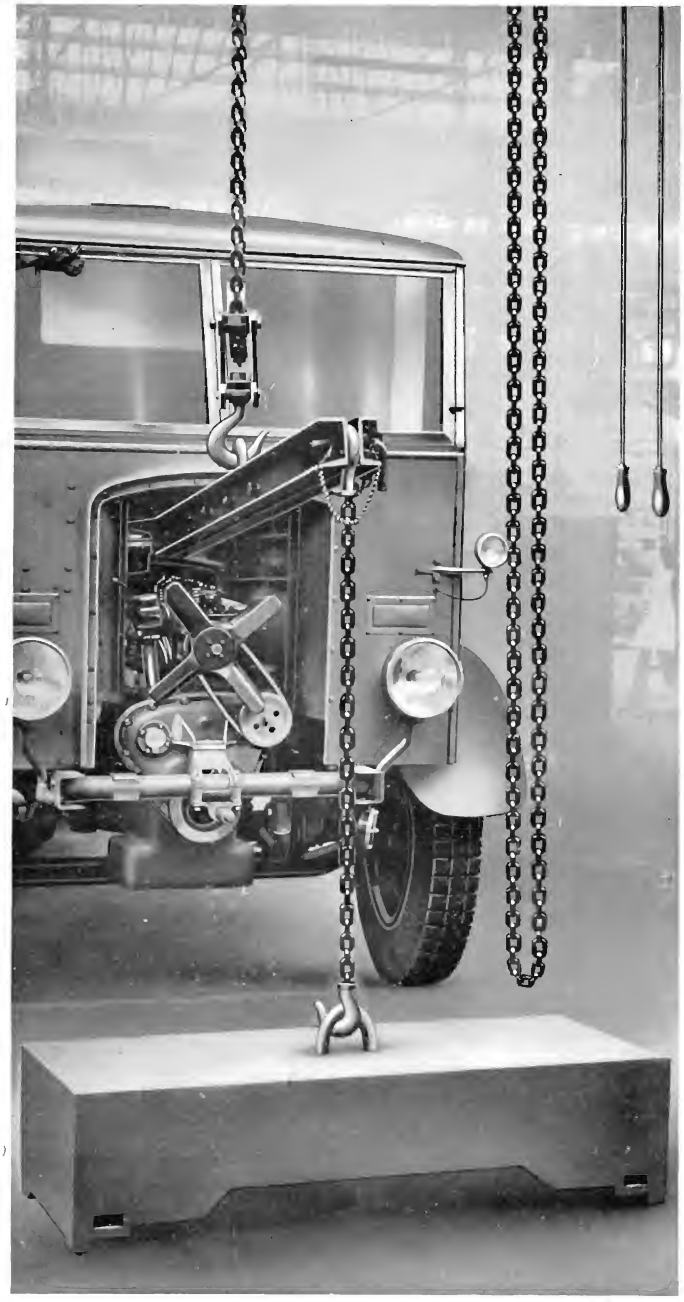


Fig. 29.
REMOVAL OF ENGINE (FORWARD TYPE).

can be shaken out. **Do not prise it out and damage the housing.** The new carbon should be fitted in a like manner, great care being taken to see that the surface is not chipped or spoiled ; see that it is well home in the recess. The seat and carbon can now be lapped together. **A single piece of grit will ruin the seal during this operation, so that absolute cleanliness is essential.**

REMOVAL OF ENGINE

The engine can be removed as a complete unit on both bonneted and forward type machine, without disturbing the cab, provided that suitable lifting tackle is available. Disconnect all connections with the chassis, such as wiring for dynamo and starter motor. Exhaust pipe and carburetter controls must be disconnected. Remove the propeller shaft and gearbox (see " Removal of Gearbox ") and remove the radiator. The engine should then be slung as shown in Fig. 27 and the detachable front cross member removed. When the engine has been swung forward to clear the dowels in the rear cross member, it is free to be raised to the necessary height and removed. On forward type machines, the carburetter should be removed to prevent damage and a beam and balance weight arranged as shown in Fig. 29.

If no lifting tackle is available, the engine must be dismantled as far as possible. The head, sump and all auxiliaries should be removed and then with the aid of jacks and packings, the engine can be removed.

SECTION 7A

INDEX

GENERAL DESCRIPTION

All the auxiliaries are placed in accessible positions so that adjustments may be carried out easily and quickly.

The ignition coil (1), Fig. 1, is mounted on the dash and on the right-hand side of the engine are grouped the carburetter (2), the vacuum control (5) and the ignition distributor (6).

On the left-hand side of the engine are the dynamo, the starter-motor and the petrol feed pump.

When magneto ignition is fitted, the magneto is mounted on the right of the crankcase immediately behind the timing case.

COIL AND DISTRIBUTOR

The coil-and-distributor ignition system is fitted as standard, the distributor being driven at half engine speed, through skew gears, by the timing chain.

As a general rule a double-pole insulated-return system of wiring is used and the coil is clearly marked "Insulated Return." On certain machines, however, the wiring is on the single-pole earth-return system. Both types are dealt with in this manual.

In both cases the distributor is of the automatic-advance type, a centrifugal device housed under the distributor rotating the cam relative to the distributor and giving an advance of 30 engine degrees. A further advance of 15 degrees is obtained by means of a suction device (5), Fig. 1, secured to the distributor timing arm. The constituent parts of the system are :—

The Battery, which must always be kept fully charged. Difficult starting is frequently due to a discharged battery.

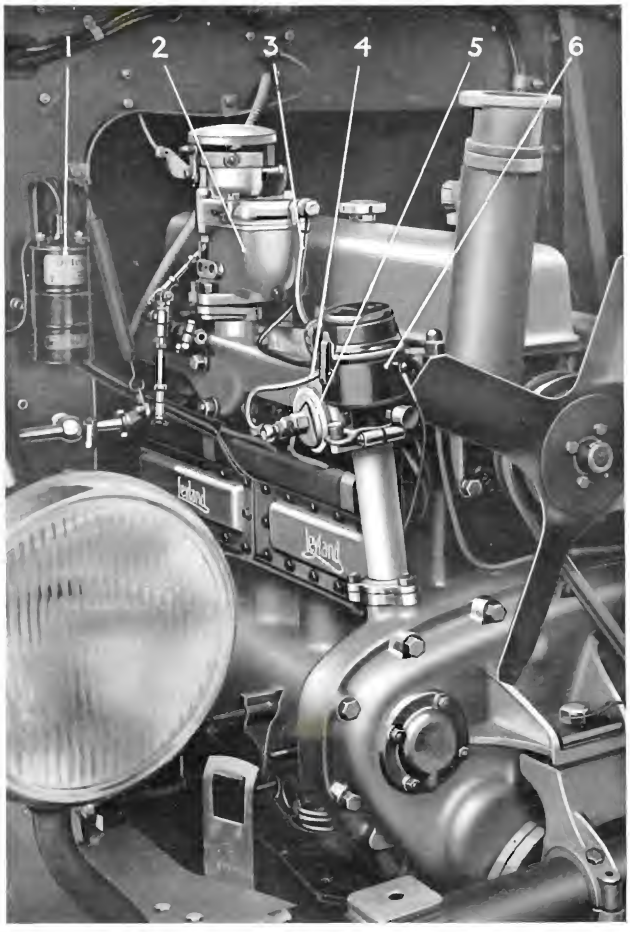


Fig. 1.
ENGINE AUXILIARIES (Right-Hand Side).
1. Ignition Coil.
2. Carburetter.
3. Feed Pipe.
4. Suction Pipe.
5. Vacuum Control.
6. Ignition Distributor

ENGINE AUXILIARIES

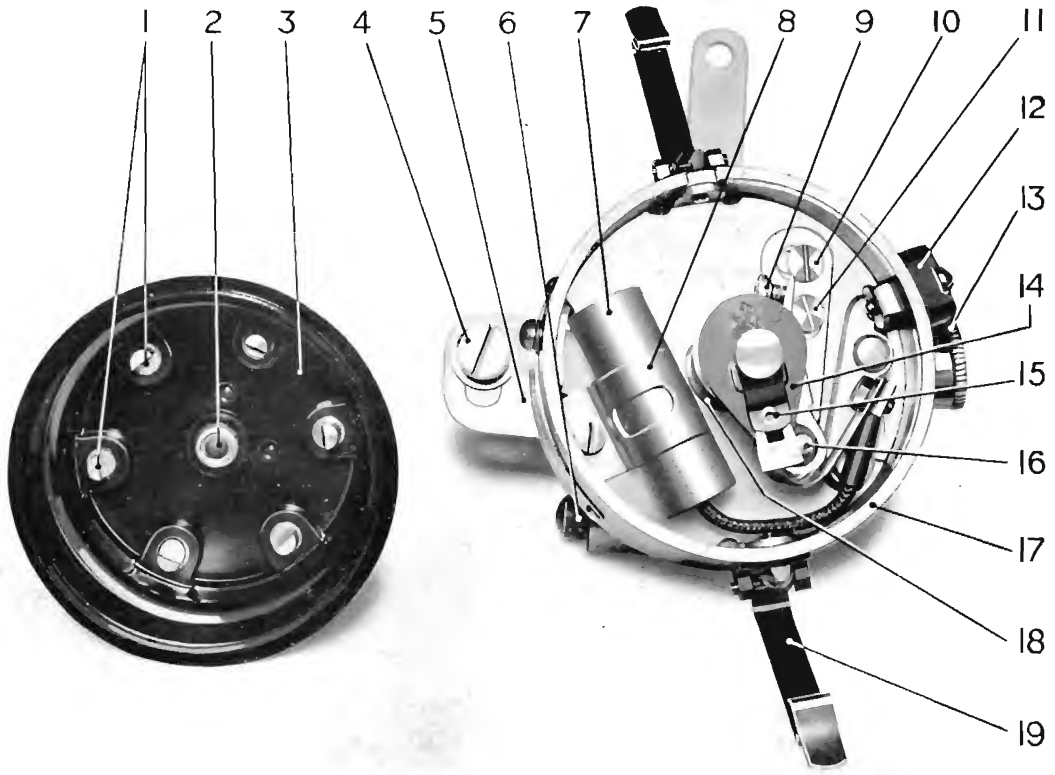


Fig. 2
DISTRIBUTOR (EARTH-RETURN TYPE).

1. Distributor Segments.
2. High Tension Terminal.
3. Distributor Cover.
4. Clamp Screw.
5. Control Arm.
6. Clamp Screw for Control Sleeve.
7. Condenser.
8. Condenser Clip.
9. Breaker Points.
10. Locking Screw.
11. Eccentric Screw.
12. Low Tension Terminal.
13. Greaser.
14. Rotor.
15. Rotor Blade.
16. Fulcrum Pin.
17. Distributor Case
18. Cam.
19. Clip for Cover.

The Coil, which transforms the battery current into a sufficiently high voltage to produce a spark at the plug points.

The Contact Breaker, which opens and closes the low-tension circuit in accordance with the firing point.

The Condenser, which reduces arcing at the contact points and increases the efficiency of quick breaking.

The Distributor, which delivers the high-tension current to the plugs in the correct firing order.

The Control Switch, on the switch-board, by means of which the battery current is switched on and off.

Earth-Return Type.

As shown in the wiring diagram Fig. 3, the positive side of the battery is connected through the control switch to the primary terminal of the coil. The other primary terminal of the coil is connected to the contact-breaker terminal and the moving breaker point. The fixed breaker point and the battery negative are earthed so that

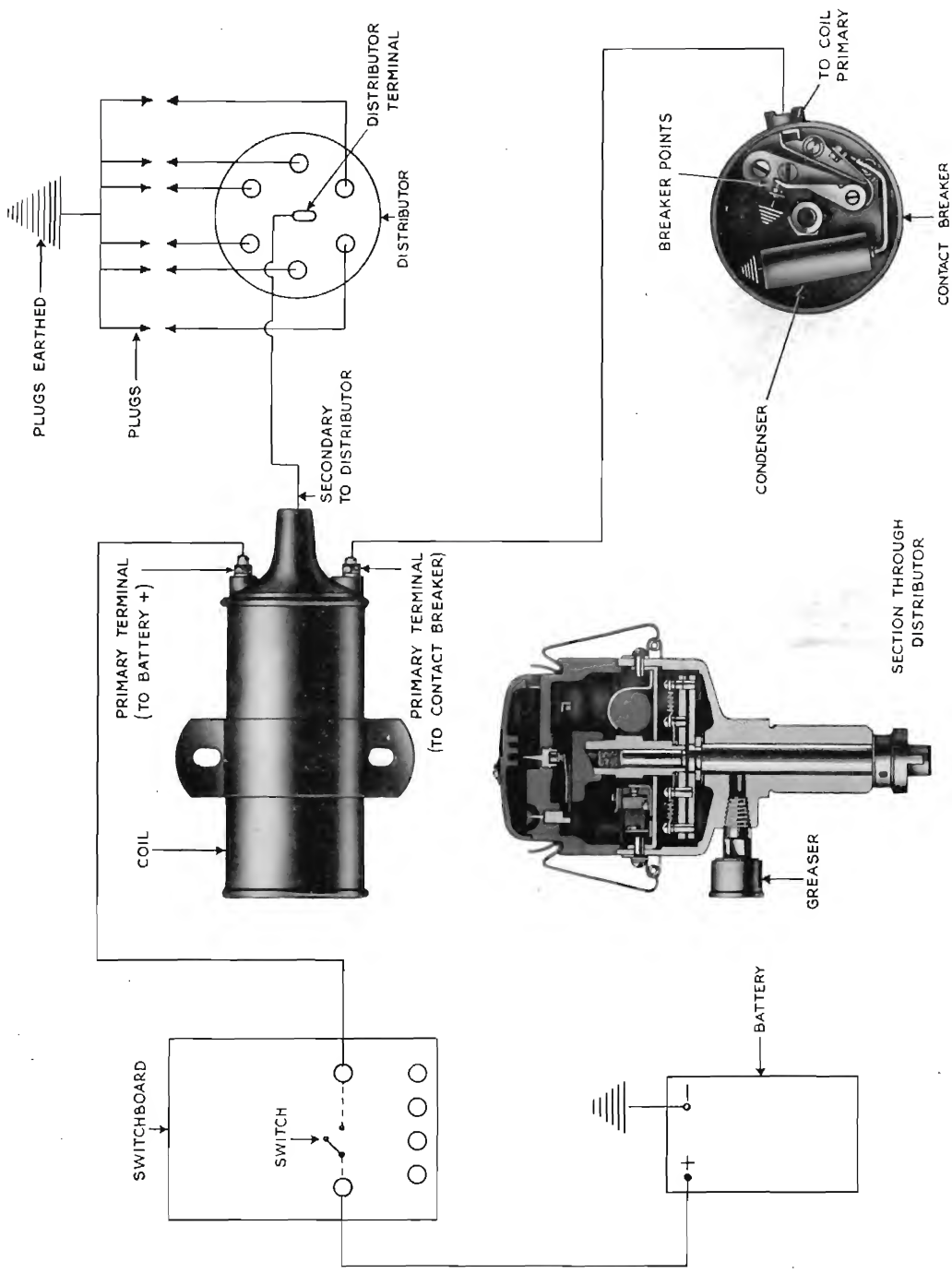


Fig. 3.
DIAGRAM OF COIL IGNITION CIRCUIT (EARTH-RETURN SYSTEM)

ENGINE AUXILIARIES

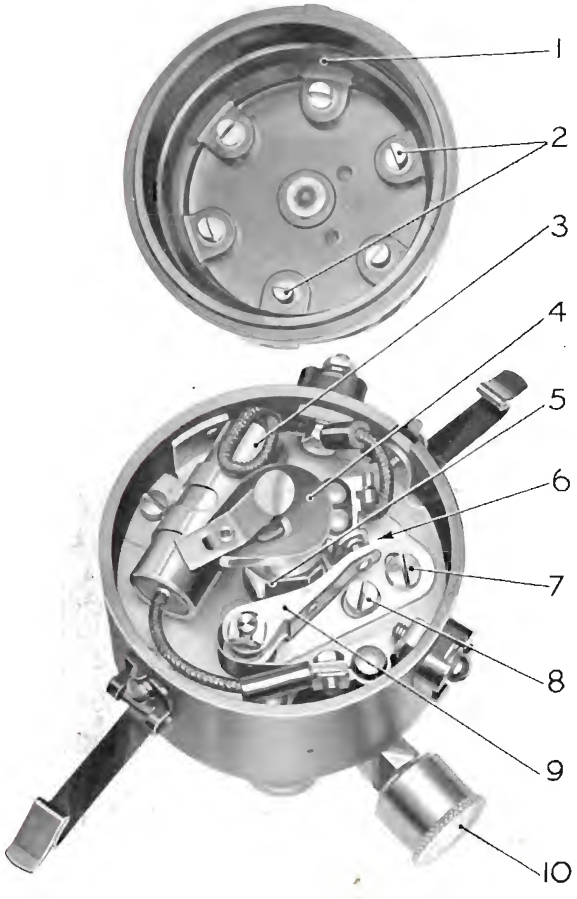


Fig. 4.
DISTRIBUTOR (INSULATED-RETURN TYPE).

1. Distributor Cover.
2. Distributor Segment.
3. Condenser.
4. Distributor Rotor.
5. Cam.
6. Breaker Points.
7. Locking Screw.
8. Eccentric Screw.
9. Breaker Arm.
10. Greaser.

the low tension circuit is completed through the contact points and earth. The condenser is connected across the contact points as shown.

One end of the secondary winding is connected to the centre terminal of the distributor and through the rotor and cables to the sparking plugs. The other end of the secondary is connected to one end of the primary so that the high tension circuit is completed through the plugs and earth to the negative terminal of the battery.

Insulated-Return Type.

The wiring diagram Fig. 5, shows the circuit for the double-pole system. The battery positive is connected through the control switch to the primary terminal of the coil. The other primary terminal is connected to the contact-breaker terminal. The low tension circuit is completed through the contact points to the battery negative which is connected to the terminal. The condenser is connected across the breaker points.

One end of the secondary winding is connected to the high tension terminal of the distributor and through the rotor to the plugs by way of the cables. The other end of the secondary is earthed so that the high tension circuit is completed through the plugs and earth to the coil.

Operation.

When the primary circuit is completed by switching on and the engine is turned, the cam opens the contact points and suddenly breaks the primary circuit. The sudden rupture of the primary circuit induces a high-voltage current in the secondary winding, which being connected through the distributor to the plugs, causes a spark at the plug points.

Lubrication.

Distributor Spindle. Give the greaser (13) Fig. 2, (10) Fig. 4, a half turn every 500 miles and replenish with grease when necessary.

Distributor Camshaft. A few drops of light engine oil should be given to the felt wick in the top of the shaft under the rotor (14) Fig. 2, (4) Fig. 4, every 500 miles.

Breaker Arm Fulcrum Pin. Lubricate the fulcrum pin (16) Fig. 2, sparingly when docking.

Cam. The faces of the cam should be lightly smeared with the vaseline when docking.

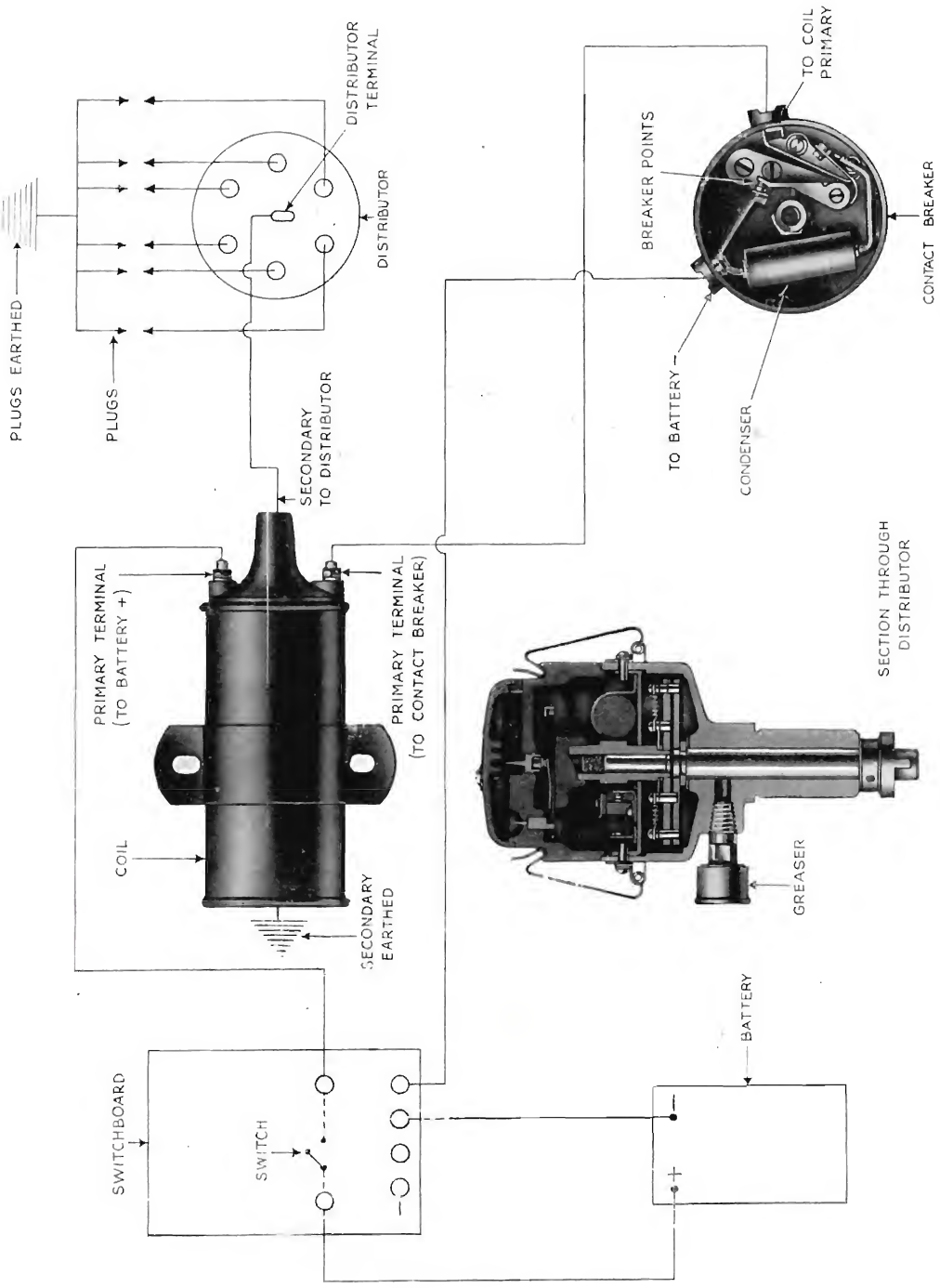


Fig. 5.
DIAGRAM OF COIL IGNITION CIRCUIT (INSULATED-RETURN TYPE).

ENGINE AUXILIARIES

Do not over lubricate ; the contact points should be kept free from oil or grease or they will burn rapidly.

Adjustment.

The only parts requiring occasional adjustment are the contact points and the sparking plug gaps. To adjust the contact points slack off the screw (10) Fig. 2, (7) Fig. 4, and turn the eccentric screw (11) Fig. 2, (8) Fig. 4, until the gap between the points is .015 in. then tighten the locking screw.

The plug points should be set with a gap of .020 in.

Maintenance.

Check the contact points and plug gaps and adjust as outlined under "Adjustment" every 5,000 miles. Running with too large a gap on the plug points overloads the coil which may eventually give trouble.

Examine the wiring every dock and see that there is no corrosion, check that the earth wire is making good contact. **Keep the battery fully charged at all times. Do not leave the switch on as this will run down the battery and may cause trouble with the coil.**

Dismantling Distributor (Both Types).

The distributor should not be disturbed if it is functioning satisfactorily but at overhaul it may be desired to dismantle for inspection. Take off the cover (3), Fig. 2, complete with cables and remove the clips (19). Remove the screws securing the contact breaker plate and withdraw the plate, the camshaft and weights shown in Fig. 3, can now be withdrawn. To remove the coupling at the bottom, the taper retaining pin must be removed and the shaft withdrawn from the top.

Timing Distributor.

When replacing the distributor the timing must be checked if this has been disturbed. If the engine has a cast-iron cylinder head, turn until No. 1 piston is on the compression stroke (both valves closed), and the mark on the flywheel is 1 in. before the mark on the clutch housing. If the engine has an aluminium head, set with the flywheel mark $\frac{3}{8}$" before the housing mark. Set the distributor with the points just breaking with the vacuum control in the out position. The tongues on the coupling are offset so that the distributor cannot be replaced 180 degrees out.

Vacuum Control.

This control (5), Fig. 1, gives an additional 15 degrees advance at small throttle openings, when the engine is running light and in no way affects the centrifugal advance device which is operated by engine speed only. The control consists simply of a small case containing a diaphragm. One side is in communication with the carburetter barrel through a suction pipe and the diaphragm is connected to the distributor control arm as shown in Fig. 1.

At small throttle openings there is a high vacuum in the carburetter barrel which acts on the diaphragm and holds the distributor advanced. As the throttle is opened wider to take increased load, the vacuum in the carburetter decreases so that the return spring retards the distributor against the reduced suction.

There is no adjustment provided, the unit is set on assembly and should require no attention. If it ceases to operate examine the suction pipe for fractures and check that the unions are tight.

MAGNETO

The Simms S.M.E.6 magneto is fitted when required by customers. The magneto is fitted behind the timing case on the right-hand side, it is held by a strap and driven by the timing chain through a vernier coupling. It is driven at $1\frac{1}{2}$ times engine speed and gives an ignition range of 40 engine degrees by means of a manual control. The control

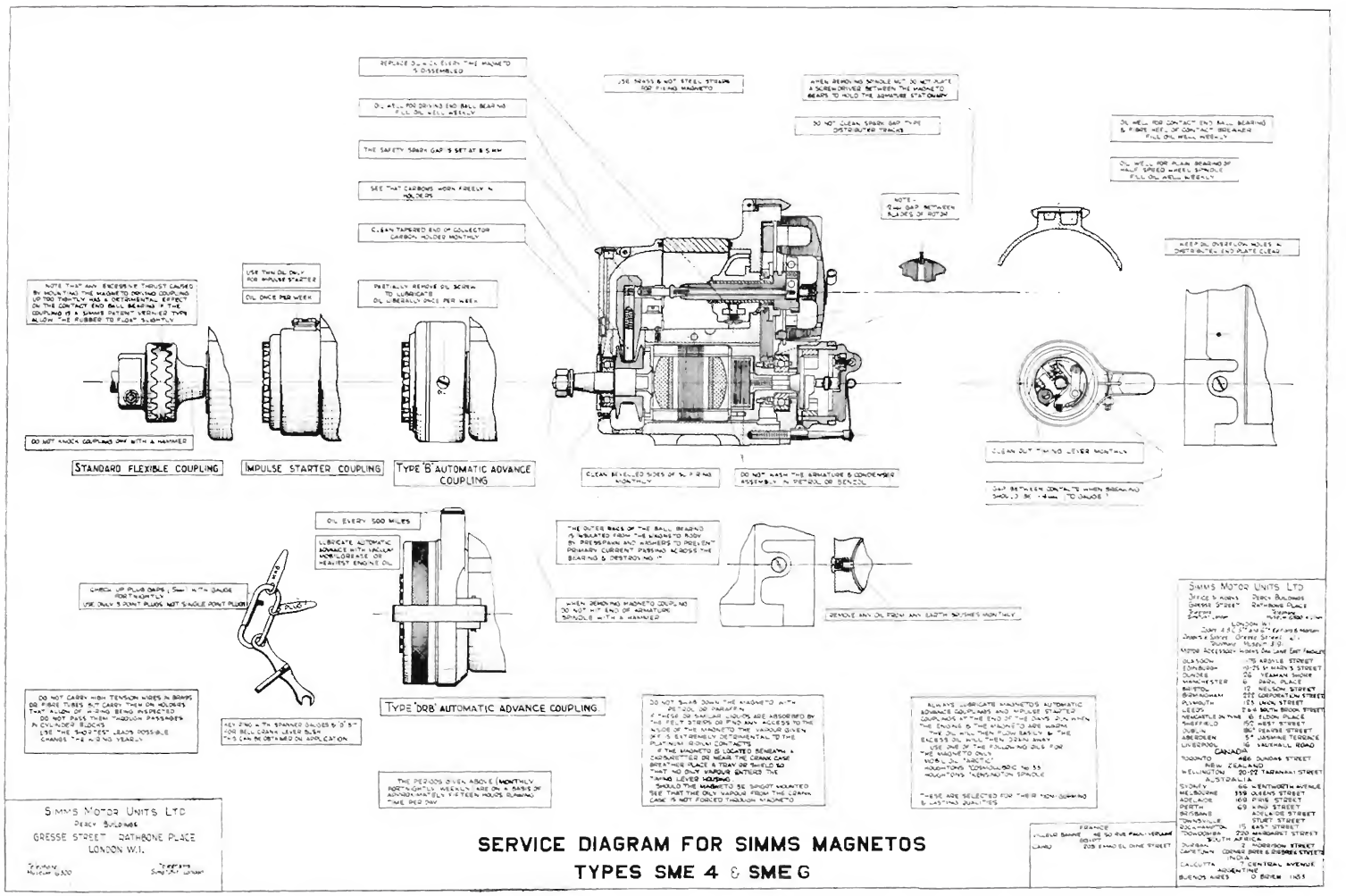

STANDARD FLEXIBLE COUPLING
IMPULSE STARTER COUPLING
TYPE 'B' AUTOMATIC ADVANCE COUPLING
TYPE 'DRB' AUTOMATIC ADVANCE COUPLING
SIMMS MOTOR UNITS LTD
PERCY BUILDINGS
GRESSE STREET RATHBONE PLACE
LONDON W.1.
SERVICE DIAGRAM FOR SIMMS MAGNETOS
TYPES SME 4 & SME 6

Fig. 6

ENGINE AUXILIARIES

should be retarded when starting, but the engine should be run with it as far advanced as possible without causing excessive pinking.

Lubrication.

Rotor Bearings. Fill up the oil boxes with high grade engine oil every 1,000 miles.

Breaker Fulcrum Pin. Lubricate the pin sparingly when docking.

Cam. The faces of the cam should be lightly smeared with vaseline when docking.

Do not over lubricate ; the contact points should be kept free from oil and grease or they will burn rapidly.

Adjustment.

The only parts requiring occasional adjustment are the contact points and the sparking plug gaps. Keep both contact points and plug points with a gap of .016 in., a gauge is provided in the tool kit. Examine the safety gap occasionally and see that it is correctly set at 10 mm.

Maintenance.

Check the contact points and adjust if necessary every 5,000 miles. Examine the high tension leads for chafing and possible shorts, renew if insulation is perished.

Overhaul should only be undertaken by a competent electrician ; a general inspection can be carried out without removing the magneto from the engine.

Timing the Magneto.

To time the magneto when replacing turn the engine until No. 1 piston is on the compression stroke, both valves closed, and the mark 1 and 6 on the flywheel is 1 in. before the mark on the housing. Trace the cable from No. 1 cylinder to the corresponding segment on the distributor and turn the magneto spindle in the direction of the arrow on the oil box lid until the rotor blade is in line with this segment and the points are just breaking, the timing lever to be in the full retard position. Set the vernier coupling so that the magneto will slide into engagement without disturbing the spindle. Do not press the magneto up too firmly as this leads to failure of the coupling and overloads the magneto end bearing ; allow the coupling to float a little.

CARBURETTER

Zenith Carburetter.

The Zenith 36.VE.1 downdraught carburetter is provided with an economy device which operates at normal running speeds. The device consists of an economy jet (4), Fig. 7, which restricts the flow of petrol to the main jet. When the throttle is more fully opened a valve (8), Fig. 8, is operated and the petrol has a free flow to the main jet. The main and compensating jets (2) and (5), Fig. 7, are situated in the base of the carburetter bowl, the economy jet (4) is in the side and the slow-running jet (7), Fig. 8, is in the top. The petrol pipe union (4) is provided with a gauze filter.

The following setting has been found on test to be most satisfactory and normally should not be altered.

Choke	30
Main Jet	135
Economy Jet	145
Compensating Jet	110
Slow-running Jet	65

Removal of Jets.

To remove the main, compensating and economy jets take out the plugs (2), (4) and (6), Fig. 7, and the jets can be removed. One of the screws (7) securing the bowl is provided with a square end and can be used with a spanner to unscrew the jet plugs and

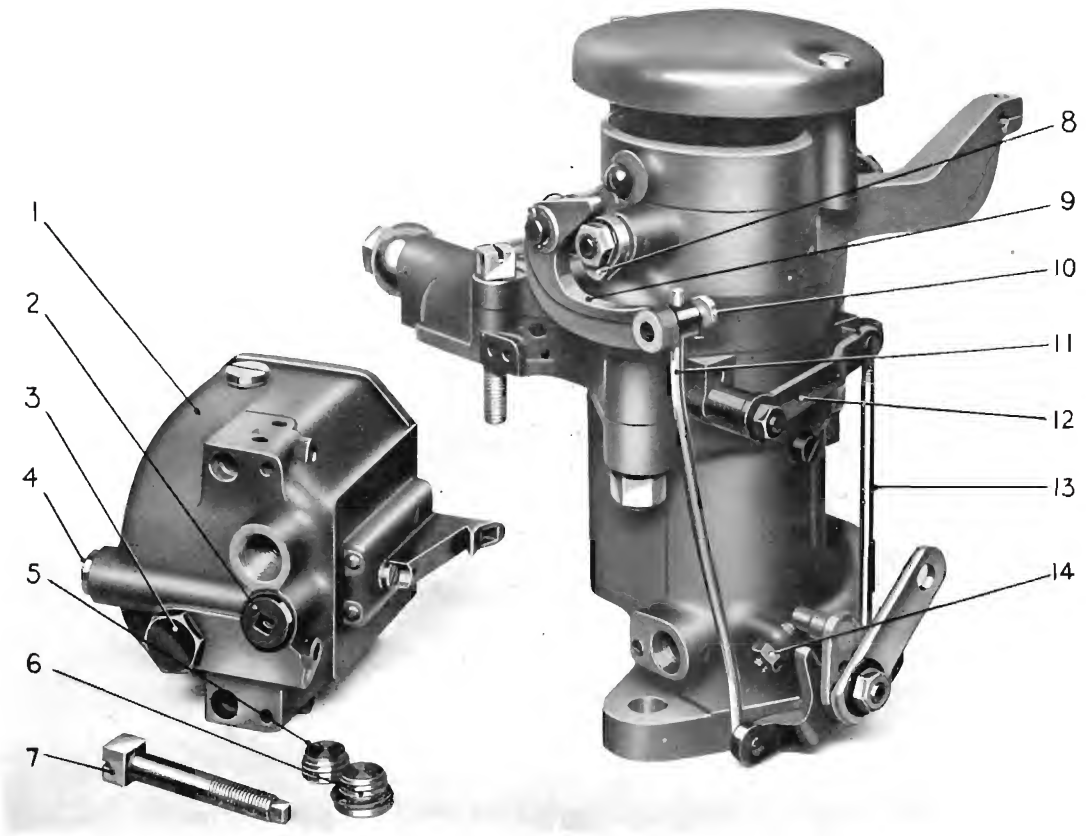


Fig. 7.
ZENITH CARBURETTER.

1. Carburetter Bowl.
2. Main Jet Plug.
3. Drain Plug.
4. Economy Jet.
5. Compensating Jet.
6. Compensating Jet Plug.
7. Bowl Retaining Screw.
8. Operating Cam for Throttle.
9. Operating Lever for Throttle.
10. Clamp for Operating Rod.
11. Operating Rod for Throttle.
12. Economiser Operating Lever.
13. Economiser Operating Rod.
14. Throttle Stop Screw.

jets. To avoid the possibility of wrong replacement the jets have different threads. The slow-running jet (7), Fig. 8, can be removed with a screwdriver.

Adjustment.

The carburetter is adjusted to give the best possible all round performance and the setting should not require alteration. If any alteration is to be made the economy jet should not be changed. A size larger main jet will give a slight increase in power while a size smaller may improve consumption. A size smaller jet can frequently be used in summer than that used in winter. When making alterations it should be borne in mind that generally the compensator affects acceleration and pulling at low speeds, while the main jet affects maximum power and speed. The desired effect can usually be obtained after trial on these lines.

ENGINE AUXILIARIES

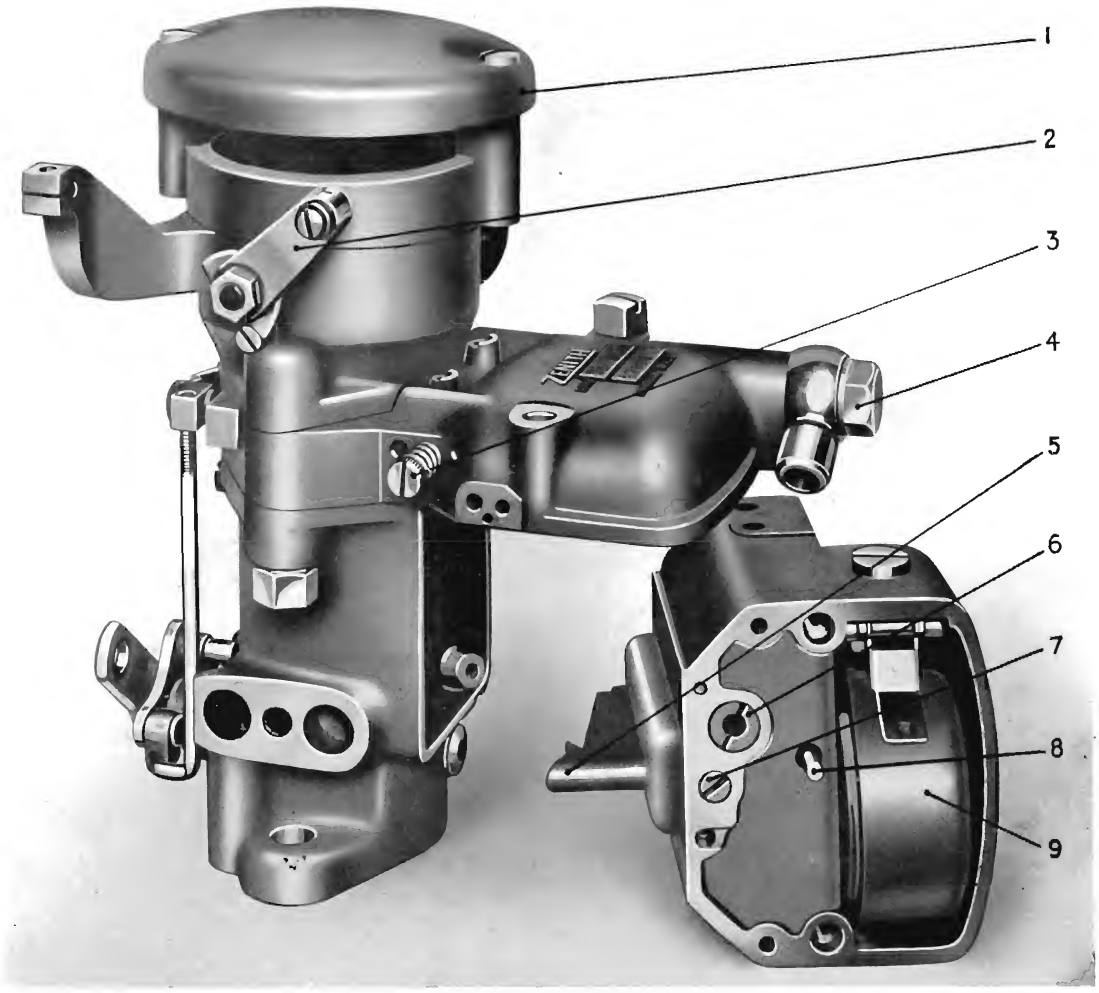


Fig. 8.
ZENITH CARBURETTER.

1. Carburetter Cover.
2. Strangler Lever.
3. Air-Bleed Screw.
4. Filter.
5. Carburetter Nozzle.
6. Capacity Tube.
7. Slow-Running Jet.
8. Economiser Plunger.
9. Float.

Slow-Running Adjustment.

This adjustment should be carried out with the engine warm. The slow-running jet (7), Fig. 8, should not be altered and in any case should be the smallest that will give satisfactory starting and slow running.

The adjustment is effected by turning the air-bleed screw (3), Fig. 8, and the throttle stop screw (14), Fig. 7. Careful adjustment of these two screws will give satisfactory slow running. Too rich a mixture will cause the engine to hunt and a deposit of soot will form on the plug points. Too weak a mixture will cause an irregular misfire and make starting difficult.

Strangler.

The strangler is interconnected with the throttle so that when the strangler is closed the throttle is opened the correct amount for easy starting. The strangler is spring loaded and freely pivoted on a spindle in the main air intake. It is connected to the throttle control by an adjustable rod (11), Fig. 7, the lever (9) and the cam (8) and is operated from the cab. The wings of the butterfly are of unequal sizes, so that as the engine speeds up and the air velocity increases the strangler is automatically opened against the spring and the engine cannot receive an unduly rich mixture. When the strangler is closed by pulling out the control, the cam (8) operates the lever (9) and opens the throttle the correct amount. The rod (11) can be adjusted to give the correct throttle opening by slacking off the clamp screw (10).

Starting.

Pull out the strangler control and turn the engine by hand with the switch off. Switch on, engage the starter (when fitted) and start the engine. Leave the strangler control out until the engine has warmed up and then push it home.

If starting is difficult check that petrol is reaching the carburetter (operate the feed pump by hand) strangler is closed and that the rod (11) has not slipped. If these points are in order, bad starting is most likely due to weak spark, air leaks or worn valve guides.

Maintenance.

Do not alter the carburetter setting without first deciding that the trouble is not caused by faulty valves, incorrect valve or ignition timing, air leaks or wrong sparking plug gaps.

In case of excessive consumption check that there are no leaks or flooding. If flooding occurs see if the float is punctured, if so immerse in hot water to evaporate the petrol and note the position of the leak by the bubbles. When soldering do not increase the weight of the float by using more solder than is necessary. Drop the bowl, remove and clean the needle valve. Do not grind in the valve, clean with petrol and rotate on its seat, renew if the trouble is not cured. Check that all jets and jet plugs are tight.

For shortage of fuel remove the screw (4), Fig. 8, from the petrol pipe union and clean the filter. Popping back may be caused by water or a choked main or compensating jet; remove the jets and clear by blowing through them.

Remove the filter (4) weekly, clean and replace. At overhaul the carburetter can be dismantled and cleaned, care being taken when replacing the choke tube that the smallest diameter is to the top.

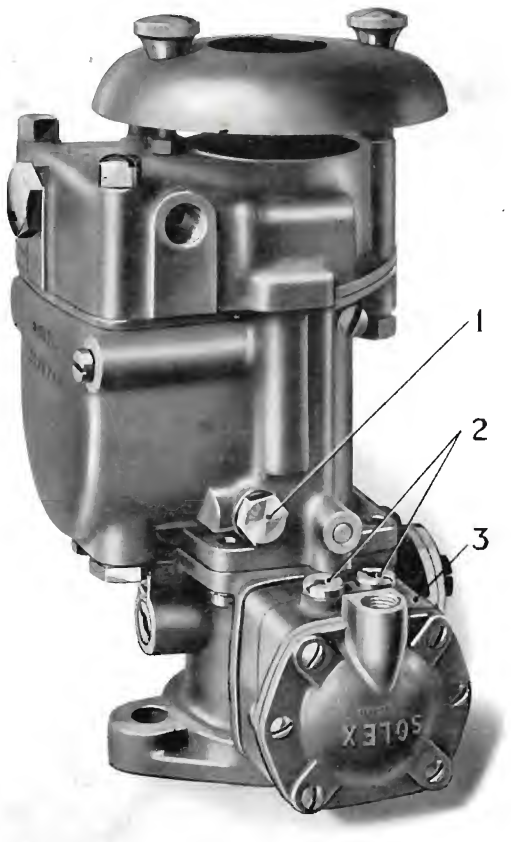


Fig. 9.
SOLEX CARBURETTER.
1. Starter Petrol Jet.
2. Starter Air Jet.
3. Starter Carburetter.

ENGINE AUXILIARIES

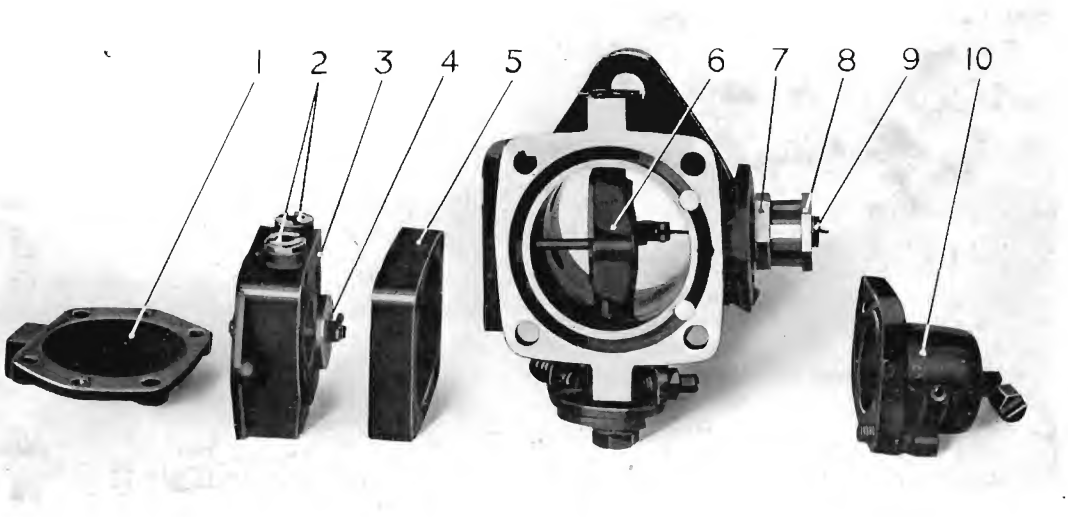


Fig. 10.

STARTER AND GOVERNOR (SOLEX CARBURETTER).

1. Starter Cover.
2. Starter Air Jets.
3. Starter Carburetter.
4. Starter Valve.
5. Adaptor for Starter.
6. Throttle.
7. Tension Screw.
8. Governor Sleeve.
9. Governor Spring.
10. Governor Cover.

Solex Carburetter.

The Solex downdraught carburetter, type 40 R.I.T.L., incorporating a thermostarter and governor gives easy starting under all conditions, is economical and prevents overspeeding of the engine with its resultant excessive wear.

It is virtually two carburetters, the starter (3), Fig. 9, being a small carburetter built into the side of the main unit. The starter provides a rich mixture for starting purposes and is automatically cut out by means of a thermostat control when the engine has warmed up.

When starting from cold the mixture is drawn from the starter which has air jets (2) on top of the body and a petrol jet (1) of such sizes as to give a correct starting mixture. When the engine has warmed up the starter is cut out by the thermostat and the engine idles on the normal slow running arrangement.

Thermostarter.

The thermostat control consists of a bi-metal strip attached to the exhaust manifold and an air pipe connected to the starter behind a diaphragm. While the engine is cold the pipe is open to the atmosphere and the suction in the starter, when the engine is turned, operates the diaphragm in the starter (3), Fig. 10, which opens the starter valve (4). As soon as the exhaust manifold reaches a pre-determined temperature the bi-metal strip expands and closes the air pipe thus releasing the pressure on the diaphragm and closing the starter valve.

The thermostat should require no attention but if there is any tendency for the starter to remain in operation when the engine has warmed up check that the pipe is being closed by the bi-metal strip and that the pipe unions are tight so that there is no leakage of air.

The starter is carefully adjusted and the setting should not be altered except that the

petrol jet (1), Fig. 9, may be changed to meet abnormal climatic conditions. **The air jet must on no account be altered.** If the starting mixture is too rich as shown by black smoke at the exhaust a smaller petrol jet should be fitted. Should the engine be difficult to start the mixture may be weak and a size larger petrol jet should be fitted.

Idling Adjustment.

The slow running jet (1), Fig. 11, is situated in the carburetter barrel above the control lever and is accessible from outside. Adjustment for idling is effected by turning the throttle stop screw (4) on the control lever and the air bleed screw behind the governor housing at (3) until the desired speed is obtained. A size larger or smaller slow running jet can be tried if the required adjustment cannot be obtained with the adjusting screws.

Main Carburetter Adjustment.

The main jet (2) is housed in the float chamber and may be removed by unscrewing the hexagon at the side of the float chamber. The size of jet fitted is suitable for all round performance but a size larger jet can be fitted for an increase in power or a size smaller for more economical running. A size smaller jet can frequently be used in summer than that used in winter.

Jet Settings.

The standard carburetter setting is as follows :—

Starter.

Air jets (2)	...	5
Petrol jet	...	155

Main Carburetter.

Choke	... ...	31
Main jet	... ...	160
Slow running jet		55 D.D.
Air bleed jet	...	2.8

Governor.

The governor is extremely simple consisting of an adjustable spring (9), Fig. 10, controlling the throttle butterfly (6). The governor spring and its adjustment are housed in a cover (10) on the opposite side to the starter, an extension of the spring being hooked to the butterfly. The butterfly is freely pivoted on the spindle and is held closed by the throttle control return spring ; the governor spring pulls it open as the pedal is depressed. The wings are of unequal size so that as the engine speed and thus the gas velocity increases the butterfly tends to close and is restrained by the spring, the degree of closing being pre-determined by the adjustment of the spring.

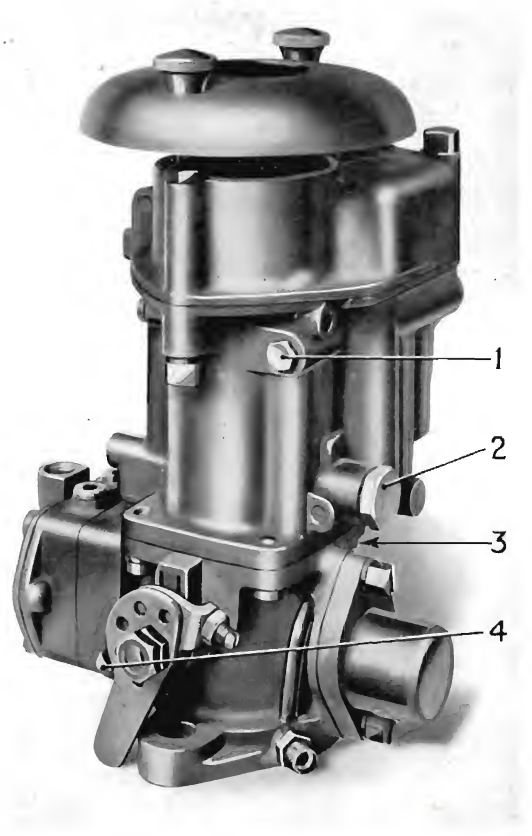


Fig. 11.
SOLEX CARBURETTER.

1. Slow-Running Jet.
2. Main Jet.
3. Air-Bleed Screw.
4. Throttle Stop Screw.

ENGINE AUXILIARIES

The governor is correctly adjusted before delivery and the setting should not be altered ; provision is made for sealing the governor housing. If, however, adjustment becomes necessary two factors must be considered : the tension of the spring and the number of coils left free.

Adjustment of Governor.

Remove the cover (10) and to strengthen the spring and so increase the speed at which the governor cuts in, it is only necessary to turn the tension screw, inner hexagon (7) in an anti-clockwise direction without touching the sleeve, outer hexagon (8). To reduce the tension turn in a clockwise direction.

To determine the number of coils to be left free, both the tension screw (7) and the sleeve (8) should be turned together until the engine, when at full throttle running light, has 5 per cent. to 10 per cent. higher speed than at full throttle fully loaded.

If the increase is greater than this turn both sleeve and tension screw together anti-clockwise. If the engine speed is greater under load than when light at full throttle the butterfly will oscillate and will not operate correctly. In this case the sleeve and tension screw should be turned clockwise.

The system is very sensitive and one-sixth of a turn at a time is all that is advisable when making adjustments.

Carburetter Maintenance.

Do not alter the carburetter setting without first deciding that the trouble is not caused by faulty valves, incorrect valve timing or air leaks.

In case of excessive consumption first check that there are no leaks or flooding. Check that the ignition timing is correct and that the thermostat is cutting out the starter when the engine is warm. This is easily noticeable by the difference in engine speed when the change over takes place.

If flooding is apparent, check that the fuel level is correct by taking off the top cover and removing the jet shroud. The level should be 2 mm. below the top of the tube. If the level is high check for punctured float and the needle valve for correct seating.

For shortage of fuel, examine and clean the filter in the banjo union. Popping back may be caused by water or a choked main jet. Check that the petrol pump is delivering fuel.

PETROL FEED PUMP

Petrol is fed to the carburetter by a small pump fixed to the crankcase and driven by an eccentric on the camshaft. The operating lever (17), Fig. 12, is pivoted at (18), and when the eccentric rotates, the collar (23) is depressed, thus pulling down the diaphragm (28). This creates a vacuum above the diaphragm and petrol is drawn into the pump chamber, whence it passes through the filter (12) and inlet valve (9) into the pressure chamber. When the lever (17) is on the back of the eccentric, the spring (25) pushes the diaphragm up and forces petrol past the outlet valve (4) to the carburetter. A certain level of petrol is maintained in the bowl (6) whilst running, and the slightly compressed air in the bowl causes a small volume of petrol to flow to the carburetter to make good evaporation losses in the float-chamber, when the engine is at rest.

When the float-chamber is full the float-chamber needle-valve closes and pressure is built up above the diaphragm. This causes a lag on the up-stroke between the operating lever (17) and collar (23), which shortens the effective length of the stroke and reduces the petrol supply. The lever (17) is kept in contact with the eccentric by the spring (19) to prevent noise.

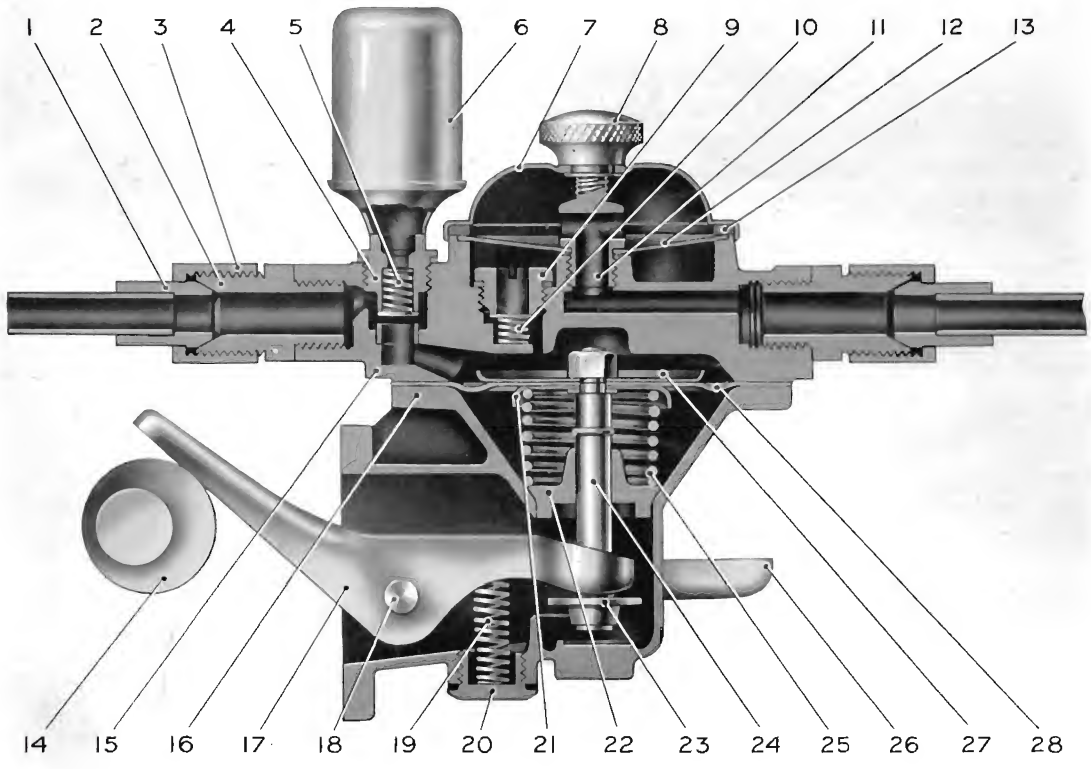


Fig. 12.
SECTION THROUGH PETROL FEED PUMP.

1. Petrol Pipe.
2. Petrol Pipe Union.
3. Petrol Pipe Union Nut.
4. Outlet Valve.
5. Outlet Valve Spring.
6. Reserve Bowl.
7. Filter Bowl Cover.
8. Filter Bowl Nut.
9. Inlet Valve.
10. Inlet Valve Spring.
11. Filter Centre.
12. Gauze Filter.
13. Cork Joint.
14. Eccentric on Camshaft.
15. Pump Body (Top Half).
16. Pump Body (Bottom Half).
17. Operating Lever.
18. Operating Lever Pivot Pin.
19. Operating Lever Return Spring.
20. Plug for Spring.
21. Operating Spring Collar (Top).
22. Operating Spring Collar (Bottom).
23. Pump Spindle Collar.
24. Pump Spindle.
25. Operating Spring.
26. Priming Lever.
27. Diaphragm Retaining Plate.
28. Diaphragm.

Maintenance.

The filter bowl (7) should be removed once a month and any dirt on the filter face gently wiped away. **Do not remove the filter as dirt may enter one of the valves.** Tighten the bowl screw firmly when replacing.

The pump should function indefinitely without any further attention, but should trouble be experienced with petrol supply it may be due to one of the following causes:—

1. Tank empty.

2. Loose Pipe Unions or damaged pipes. Check over, tighten unions and renew pipes if damaged.

3. Filter Bowl Nut Loose—Remove bowl, examine cork joint, renew if damaged and tighten bowl nut.

4. Choked Filter—Clean as outlined above.

ENGINE AUXILIARIES

5. Leaking Valve Plug—Tighten outlet by spanner on hexagon beneath the bowl (6). If inlet, remove centre by passing small bar through the hole in the filter centre (11), release gauze (12) and tighten valve with screwdriver.

6. Leakage of Petrol at Diaphragm Flange —Tighten all screws equally and gently in rotation.

7. Flooding at Carburetter—Float-chamber needle-valve not seating.

A hand lever (26) is provided for priming the carburetter after removal or if level has fallen; it should only be operated with engine stopped.

Press down the lever and release, repeat until petrol fills float-chamber.

RADIATOR

SECTION 8B

INDEX

GENERAL DESCRIPTION

All radiators on both passenger and goods vehicles are of the modern deep-skirted type. They are constructed with cast-aluminium top and bottom tanks. Both tanks and side standards can be removed without disturbing the high-efficiency tubes which are used in conjunction with alloy tube plates.

The frontal area and water capacity of the radiator are such that efficient cooling is obtained under all normal conditions. Provision is made for fitting an electric immersion-heater and thermostatically-operated shutters when required.

Passenger Type Mounting.

On passenger machines the radiator is supported on the dumb irons by two feet formed on the radiator side standards, as shown in Fig. 1. The feet are mounted between rubber support blocks and located by a ferrule, the whole being secured by long bolts pulled down on large plated washers. The radiator is supported at the top by a tie-bar secured to the bulkhead.

To remove the radiator, draw off the starting handle, detach the flexible water connections and uncouple the tie-rod. Take off the front cover-plate (10), Fig. 1, remove the split-pins (9) and nuts (8) and pull out the bolts (2) upwards. The radiator can now be lifted forward and clear.

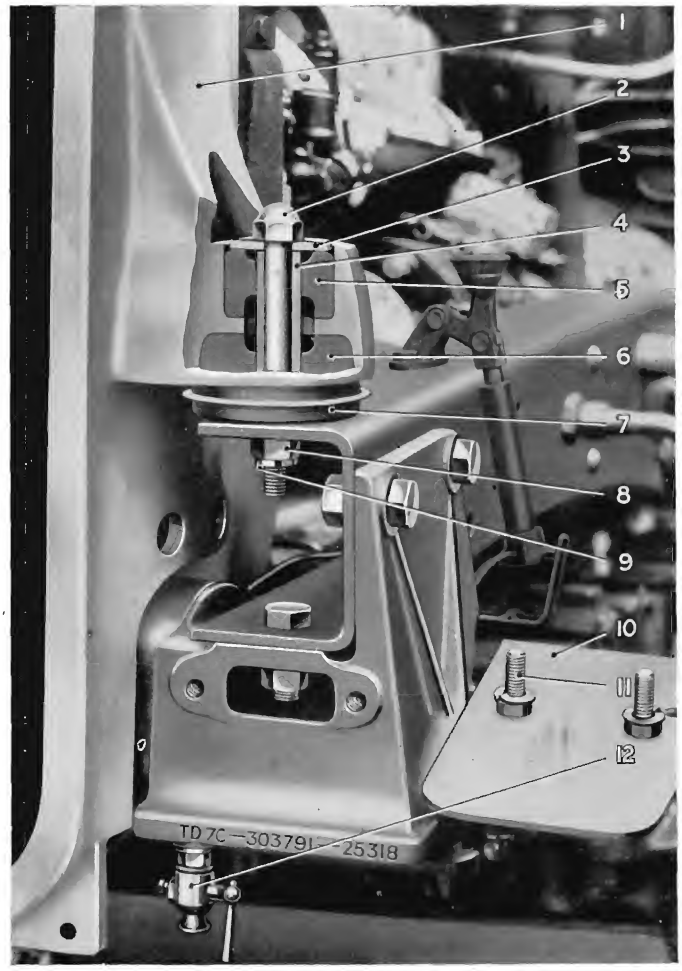
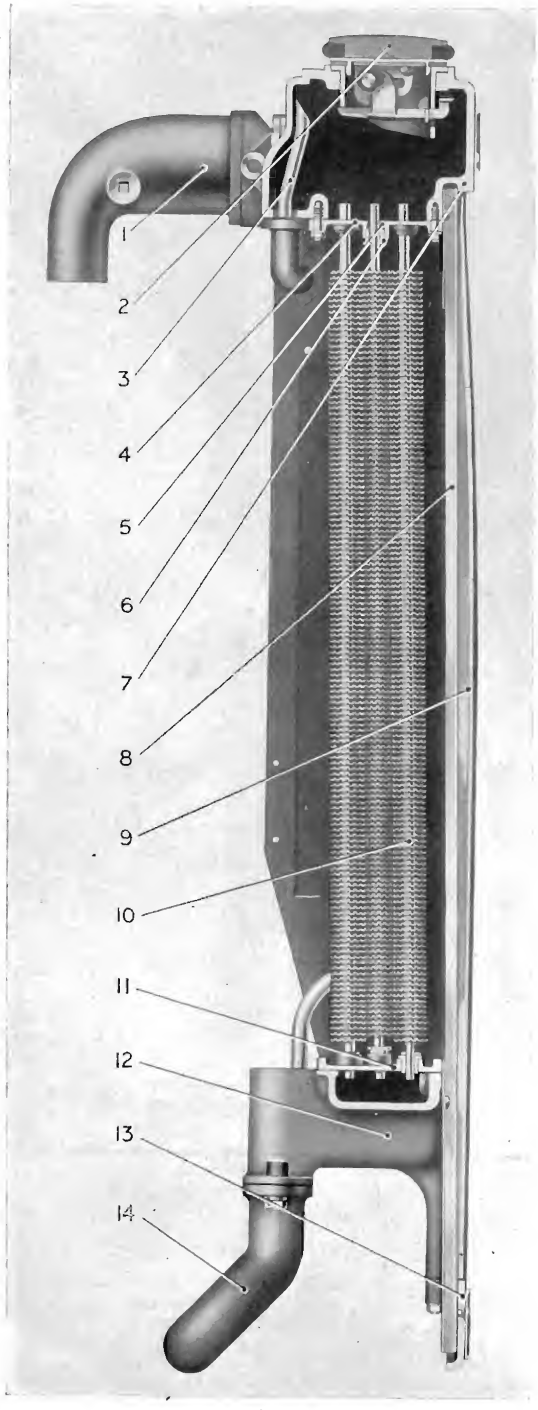


Fig. 1.

PASSENGER TYPE MOUNTING

1. Radiator side-standard.
2. Securing-bolt for radiator.
3. Bevelled washer (top).
4. Locating ferrule.
5. Rubber packing (top).
6. Rubber packing (bottom).
7. Tray for rubber packing.
8. Nut for securing-bolt.
9. Split-pin for nut.
10. Cover-plate
11. Setscrews for plate.
12. Drain tap.

RADIATOR



Light Goods Mounting.

On this type of machine with a channel-section front cross-member, the radiator is supported on two brackets secured to the cross-member. Rubber packings are interposed between the brackets and the bottom tank and the radiator is secured by two setscrews which screw into bosses formed on the bottom tank. The setscrews are wired to the brackets.

To remove the radiator, detach the water connections and starting handle and disconnect the tie-bar. Remove the two setscrews securing the radiator on the brackets and it can be lifted clear. When replacing make certain that the setscrews are wired to the brackets.

Heavy-Duty Goods Mounting.

On this type of vehicle the radiator is supported on the tubular cross-member by means of two trunnions (3), Fig. 3, formed integral with the bottom tank. The radiator

Fig. 2.

SECTION THROUGH RADIATOR

1. Water elbow (top).
2. Radiator cap.
3. Overflow pipe.
4. Top tube-plate.
5. Rubber ferrule.
6. Gland nut.
7. Top tank.
8. Radiator grille.
9. Side standard.
10. Radiator tube.
11. Bottom tube-plate.
12. Bottom tank.
13. Radiator apron.
14. Water elbow (bottom).

RADIATOR

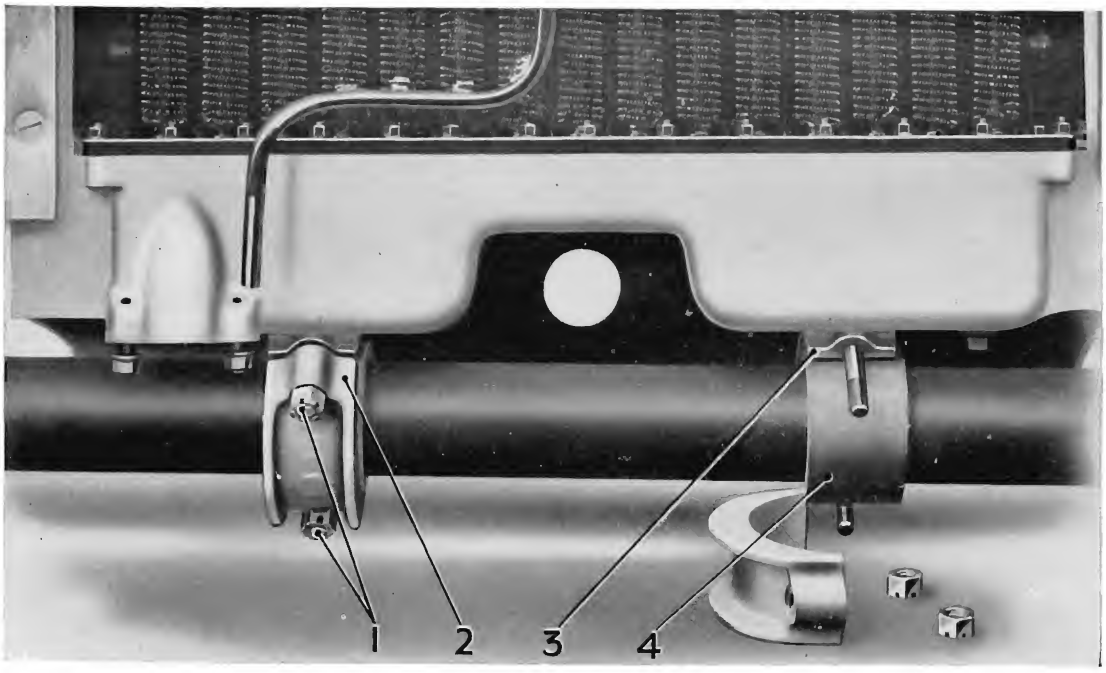


Fig. 3.
HEAVY-DUTY GOODS MOUNTING

1. Nuts for trunnion caps.
2. Trunnion cap
3. Trunnion.
4. Rubber packing.

is secured by the caps (2), rubber packings (4) being interposed to insulate the radiator from the frame. The top support consists of a short tie-bar secured to the top tank and the cylinder head.

The radiator can be removed after taking off the starting handle, detaching water connections and removing the trunnion caps. The tie-bar must then be detached from the cylinder head and the radiator can be lifted clear. It is important that the nuts (1) be split-pinned after replacement.

MAINTENANCE

Soft water, preferably rain water, should be used for filling the radiator if obtainable. The tubes should be flushed with a hose once a month and the outside of the tubes washed free from mud and dust. During periods of frost it is most important that the radiator should be drained if the vehicle is left in the open or in an unheated garage. The tap under the radiator will only empty the radiator, the cylinder block must be drained by means of the taps provided at the bottom corners of the water jacket.

RADIATOR

OVERHAUL

During annual overhaul the radiator should be thoroughly cleaned internally. If hard water has been used, the top and bottom tanks should be removed and any deposit in the tubes loosened by passing a rod down each tube. The tubes should then be thoroughly flushed out with a hose. On radiators fitted with detachable tubes, damaged tubes can easily be replaced. To remove a damaged tube, unscrew both top and bottom gland nuts (6) Fig. 2, push the tube up far enough to free the bottom end, then pull out the top end. The old rubber ferrules (5) should be removed and the cavities cleaned, new ferrules being fitted when fitting the new tube. The gland nuts should be only just finger tight whilst inserting the tube ; rotating the tube will assist this operation. When finally tightening up, do not overtighten the gland nuts, a watertight joint is ensured with little pressure. No tubes should be fitted other than those obtained from Leyland Service Dept., or the efficiency of the radiator may be impaired.

When refitting the tanks, use new joints obtained from Leyland Service Dept. and paint with red lead before fitting.

SECTION 9A

INDEX

GENERAL DESCRIPTION

The large diameter single-plate clutch of the dry type is mounted on ball bearings. It is designed so that no internal adjustment is required throughout the life of the liners, the only adjustment necessary is that which ensures that the pedal has the correct free travel and this is effected by means of an accessible nut.

An insert is spigoted on and bolted to the flywheel so that it can be removed for skimming without damaging the flywheel. The friction liners (*A*), Fig. 3, are riveted to the steel clutch plate (*B*), which is riveted to a splined hub (*C*). The pressure plate is carried on the driving plate (*D*) and located by driving pegs (*E*), the pressure being supplied by nine springs (*F*). The three withdrawal fingers (*G*) are pivoted in the lifting brackets (*H*), screwed and pegged in the pressure plate, and fulcrum on the hardened ends of the adjusting screws (*J*).

The withdrawal assembly is carried on a sleeve (*K*) bolted to the driving plate. A sleeve (*L*) is keyed on the inner sleeve (*K*) and is free to move endwise. The thrust race (*M*) and housing is carried on the sleeve (*L*) being secured in the housing by a screwed plug (*N*) and on the sleeve by the withdrawal collar (*O*). Both the plug (*N*) and collar (*O*) are locked by circlips.

The toggle levers (*P*) are clamped to a cross-shaft mounted in phosphor bronze bushes in the gearbox bell housing and operate in slots formed in the thrust race housing.

The clutch shaft is centralised in the flywheel by a ball bearing (*Q*) secured by a grease retaining plate and setscrews (*R*).

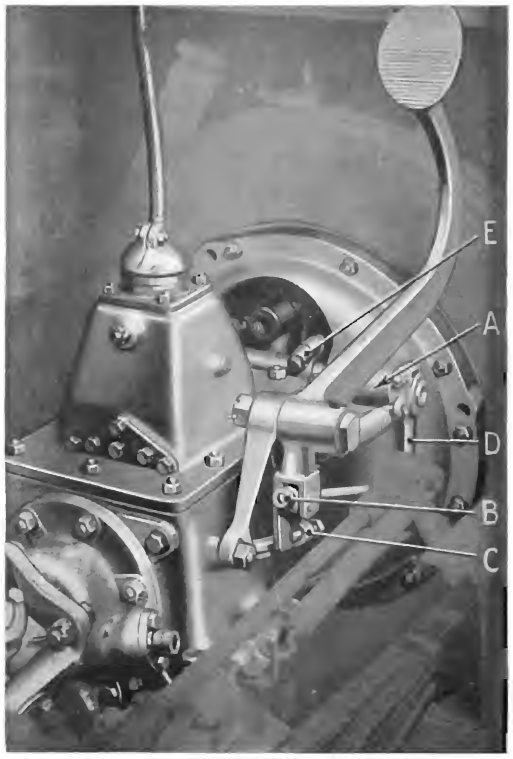


Fig. 1.
Clutch Withdrawal.

LUBRICATION

The withdrawal race is lubricated from a nipple in the chassis battery which is connected at the union (*S*), Fig. 3, separate nipples at(*A*), Fig. 1, are provided in each of the cross-shaft bushes. The centralising bearing (*Q*), Fig. 3, is packed with high-melting-point grease on assembly and only requires attention at overhaul.

Lubricate as follows :—

1. **Withdrawal Race.**—Weekly through the nipple in the chassis battery, using gear oil. Do not over lubricate as any excess oil may find its way into the clutch.
2. **Cross-shaft Bushes**—Weekly through the nipples at (*A*), Fig. 1, using gear oil.

CLUTCH

ADJUSTMENT

The only adjustment required is to maintain $\frac{3}{4}$ in. free travel on the clutch pedal. To adjust, slack off the lock nut and adjusting nut (*B*), Fig. 1 until the required free travel is obtained, then tighten the lock nut. The stop-screw (*C*) should not be disturbed.

It is essential that this free play is always maintained or clutch slip and undue liner wear will result.

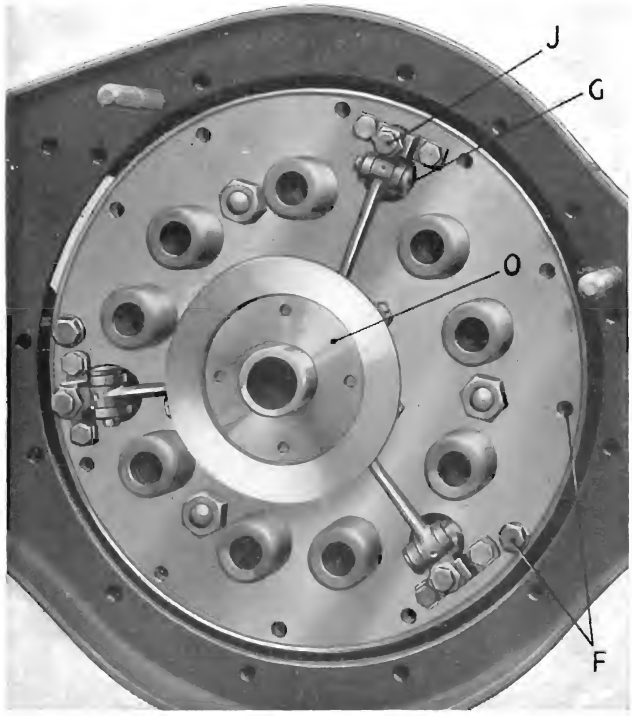


Fig. 2.
Adjustment of Withdrawal Levers.

Clutch Slip.

If the clutch slips, check the following points :—

1. That the clutch pedal has $\frac{3}{4}$ in. free play.
2. That there is correct clearance between the withdrawal fingers and the collar.
3. That there is no oil on the friction liners.
4. That the withdrawal sleeve is not sticking.
5. That the liners are not worn out.

Adjustment after Overhaul.

When the clutch has been relined the withdrawal fingers require careful adjustment. Check that the pedal is back against the stop-screw (*C*), Fig. 1, and that the lever (*D*) is vertical ; engage the toggle levers (*E*) in the slots in the withdrawal housing and tighten the clamp bolts. Adjust each of the withdrawal fingers by means of the screws (*J*), Fig. 2, so that there is .010 in. clearance between the tips of the fingers and the withdrawal collar (*O*). **It is most important that all these clearances should be equal to ensure that the clutch withdraws evenly.** Having obtained an equal adjustment, tighten the lock nuts and check that the clutch pedal has the correct free travel.

OVERHAUL

Removal of Clutch.

Disconnect the withdrawal race oil pipe at the union (*S*), Fig. 3, slack off the toggle lever clamp bolts and remove the gearbox as outlined under "Removal of Gearbox." Take out the setscrews (*F*), Fig. 2, securing the driving plate to the flywheel and the clutch can be removed. To detach the pressure plate, clamp the pressure plate and driving plate together and remove the pivot pins (*G*) from the withdrawal fingers. Slack off the clamp and the plates can be separated.

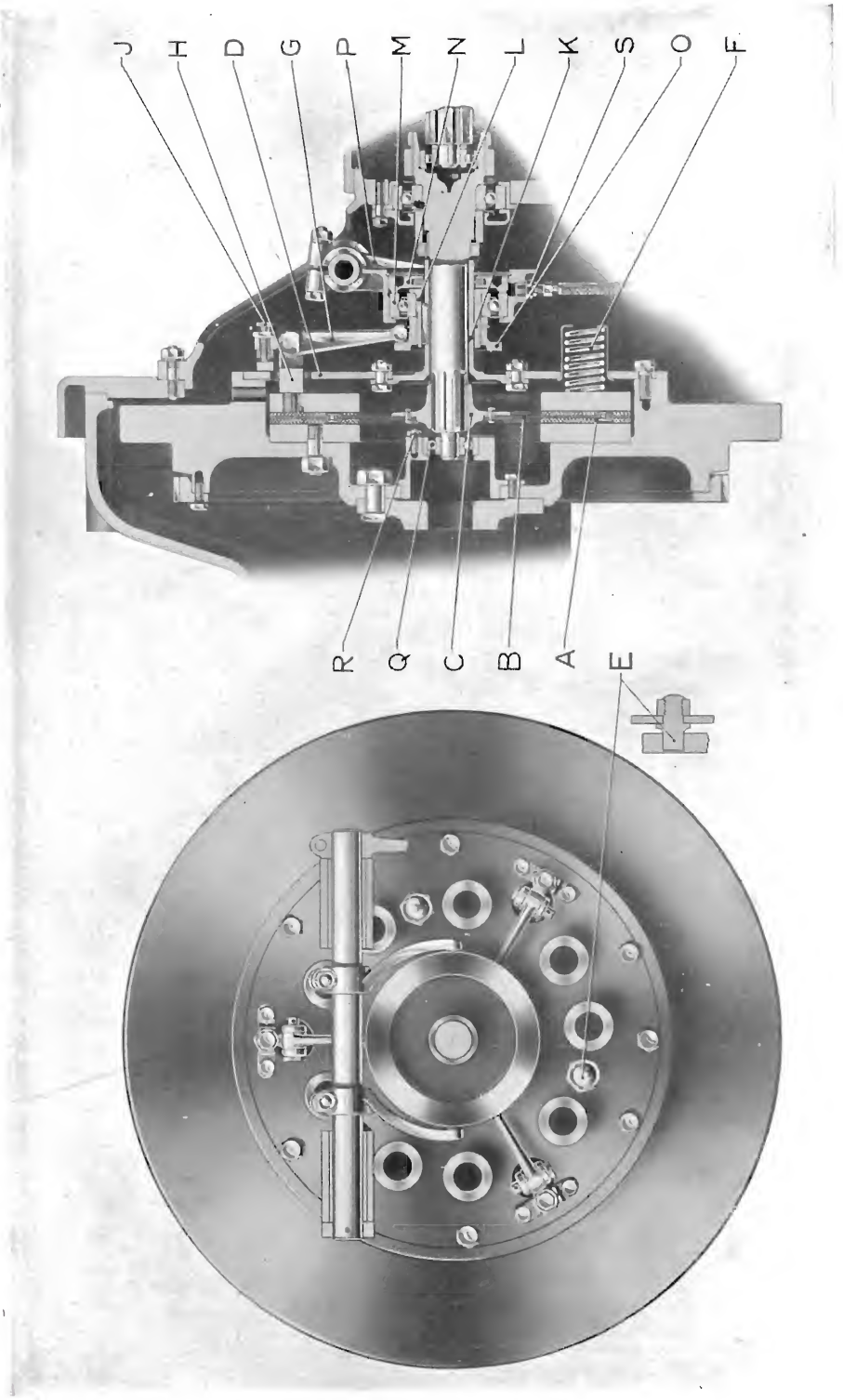


Fig. 3.
Arrangement of Clutch.

CLUTCH

Fig. 4.
Clutch Assembly.

The flywheel insert can be removed by unscrewing the nuts which secure it to the flywheel. To remove the spigot bearing take out the setscrews (*R*), Fig. 3, and remove the retaining plate.

Dismantling Withdrawal Assembly.

Release the circlips and screw out the retaining plug (*N*), Fig. 3, and withdrawal collar (*O*) ; the thrust race housing can then be withdrawn and the bearing pressed out. Check that the key and the keyway in the sleeve (*L*) are not worn as this will cause chattering. If a new one is fitted check that it will slide freely along the inner sleeve. Renew a badly worn thrust race, locking it in the housing with the locking plug and observing that one of the four slots in the plug registers with the oil hole in the housing. Lock the plug and collar with the circlips.

Re-assembling Clutch.

When re-assembling the clutch, smear the springs and driving pegs (*E*), Fig. 3, with graphite grease. Clamp the pressure plate and driving plate together and replace the pivot pins (*G*), Fig. 2, in the withdrawal levers.

Pack the spigot bearing (*Q*), Fig. 3, with high melting point grease (See Section on "Lubricants.") If the bearing has been removed, replace the retaining plate and setscrews and wire the setscrews together.

Replace the clutch in the flywheel and before tightening the setscrews (*F*), Fig. 2, centralise the clutch plate with a dummy shaft (obtainable from Leyland Service Dept.). If the plate is not centralised difficulty will be experienced in engaging the clutch shaft and clutch plate splines when replacing the gearbox. Tighten the setscrews hard with the dummy shaft in position. Remove the dummy shaft and replace the gearbox.

Adjust the withdrawal fingers carefully as outlined under "Adjustment after Overhaul" and check that the pedal has $\frac{3}{4}$ in. free travel.

Couple up the oil pipe at (*S*), Fig. 3, and lubricate the thrust race.

SECTION 10E

INDEX

GENERAL DESCRIPTION

The gearbox is of unit construction with the engine, the two being spigoted together and bolted up with the engine rear cross-member interposed.

The gearbox has a cast-iron casing and all gears are of alloy steel, hardened and ground. Helical gears are used throughout, third, fourth and fifth speeds being engaged by sliding dogs. First and second mainshaft gears are mounted on helical splines on the mainshaft, the sliding first gear also serving to engage reverse.

Five forward speeds and reverse are provided, giving the following ratios :—

Top or 5th	1 to 1
4th	1.66 to 1
3rd	2.33 to 1
2nd	4.20 to 1
1st	7.12 to 1
Reverse	7.45 to 1

A sectional view of the gearbox is shown in Fig. 4.

The selector gear and change speed are carried in the selector cover.

Combined Clutch-shaft and Pinion.

The clutch-shaft (5), Fig. 4, is mounted in a ball bearing which is secured by a circlip. The bearing is located in the gearbox by a circlip and secured by a cover (2) which has a reverse thread cut in the bore to prevent oil loss. The shaft is centralised at the front end by a roller bearing in the flywheel centre.

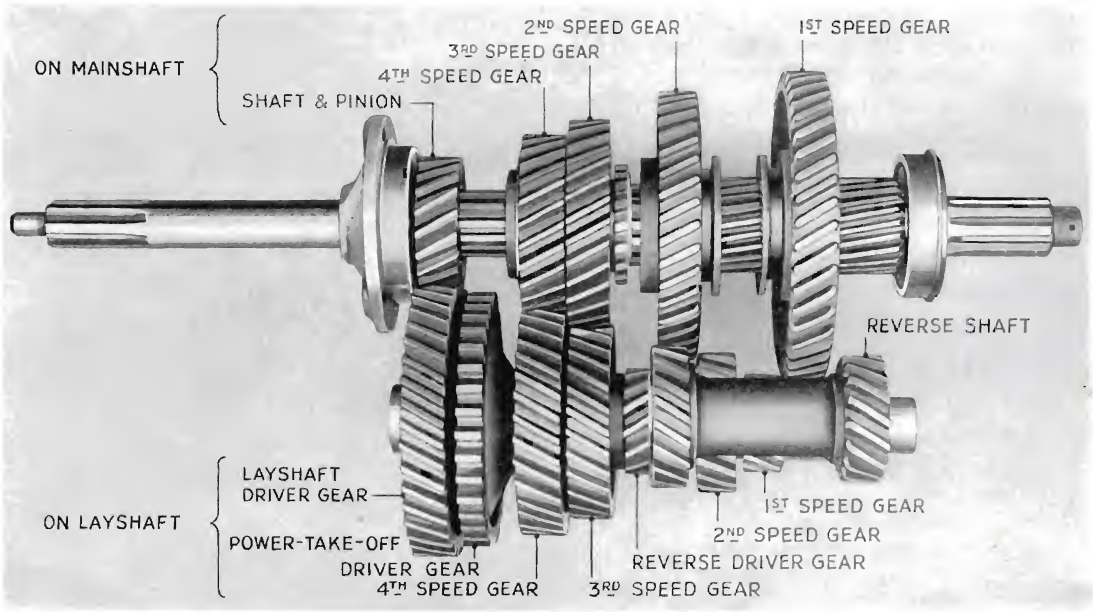


Fig. 1.
GEAR ASSEMBLY.

GEARBOX

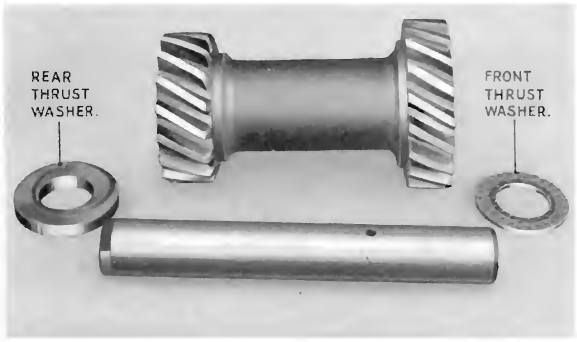


Fig. 2.
REVERSE GEAR AND SHAFT.

Mainshaft.

The mainshaft is centralised at the front end by a needle-roller bearing in the clutch-shaft pinion and carried in a ball bearing at the rear end, where oil loss is prevented by an oil seal. First and second sliding gears are mounted on helical splines, third and fourth gears are mounted on straight-splined sections of the shaft and secured by thrust washers and circlips. The sliding-dog for engagement of fourth and fifth speeds is mounted on the forward splined end of the shaft. Second speed sliding-gear has internal dogs for engagement of third speed, first speed sliding-gear also engages reverse.

Speedometer Drive.

The speedometer drive consists of a pair of spiral gears at the rear end of the mainshaft. A standard ratio is fitted on all chassis and a supplementary gearbox is provided to correct the overall ratio if necessary.

The combined pinion and shaft is carried in a bronze sleeve screwed into the rear housing, a hardened steel button locating it endwise. The spiral gear is an easy tapping fit on the mainshaft and is secured by the coupling flange. The rear bearing is secured by the cover (42) which is fitted with an oil seal.

Fig. 4.
SECTION THROUGH GEARBOX.

1. Detachable bell housing.
2. Clutch-shaft bearing cover.
3. Clutch-shaft bearing.
4. Spigot bearing.
5. Clutch shaft.
6. Top and 4th selector shaft.
7. Top and 4th selector fork.
8. Reverse lock spring.
9. Change-speed lever support spring.
10. Change-speed housing.
11. Change-speed lever.
12. Reverse lock rod.
13. Change-speed housing cover.
14. Change-speed lever spherical bearing.
15. Poppet spring.
16. Poppet ball.
17. Circlip for thrust washer.
18. Thrust washer (4th speed gear).
19. Fourth speed mainshaft gear.
20. Second and third selector shaft.
21. Third speed thrust washer.
22. Circlip for thrust washer.
23. Third speed mainshaft gear.
24. Second and third selector fork.
25. Second and third sliding gear.
26. First and reverse selector fork.
27. First and reverse selector shaft.
28. Selector housing.
29. Top and 4th sliding dog.
30. Layshaft roller bearing.
31. Circlip for thrust washer.
32. Layshaft thrust washer.
33. Layshaft.
34. Drain plug.
35. Layshaft drive gear.
36. Power take-off gear.
37. Fourth speed layshaft gear.
38. Third speed layshaft gear.
39. Mainshaft.
40. First and reverse mainshaft gears.
41. Mainshaft ball bearing.
42. Mainshaft bearing housing.

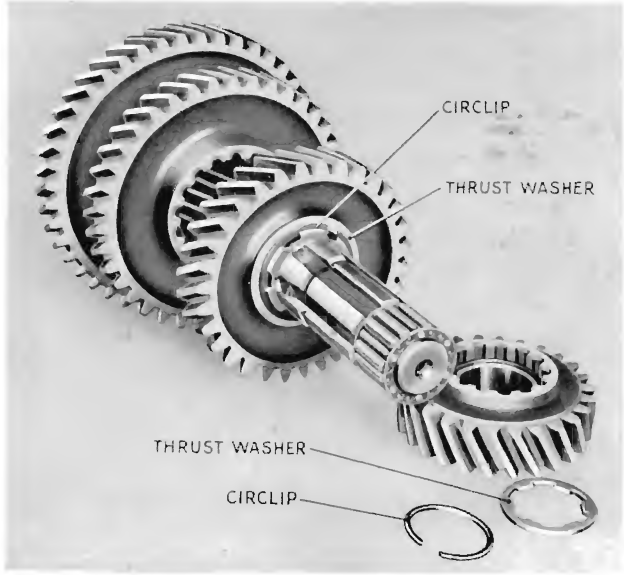


Fig. 3. METHOD OF SECURING MAINSHAFT GEARS.

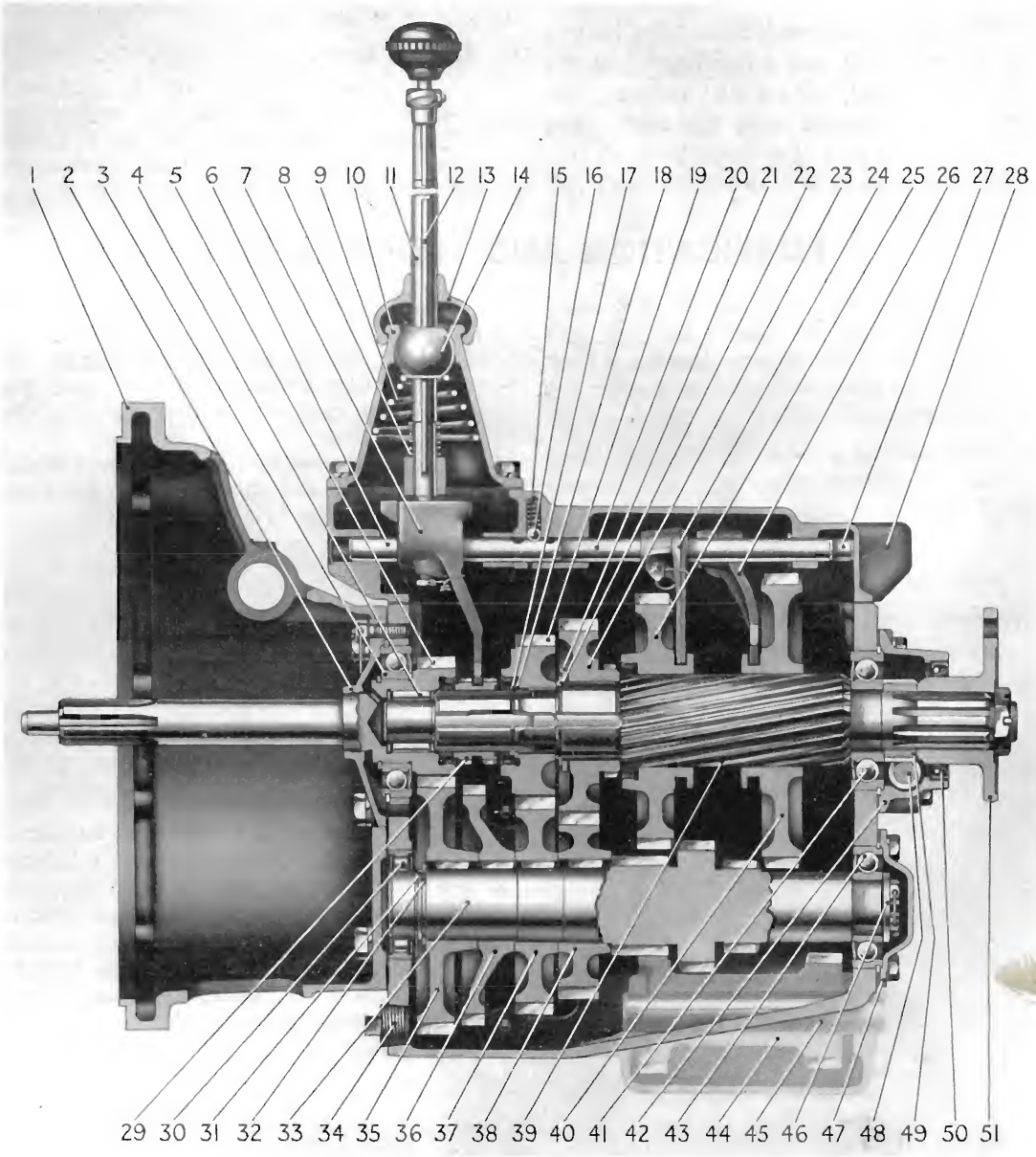


Fig. 4.
SECTION THROUGH GEARBOX

43. Layshaft ball bearing.
44. Reverse idler gear.
45. Reverse gear shaft.
46. Layshaft bearing retainer.
47. Layshaft bearing cover.
48. Speedometer drive pinion
49. Speedometer drive gear.
50. Oil seal.
51. Coupling flange.

GEARBOX

Layshaft.

The layshaft is mounted in a roller bearing at the front end and a ball bearing at the rear end. First, second and reverse gears are formed integral with the shaft. The layshaft drive gear (35), power take-off gear (36), fourth speed (37) and third speed (38) gears are pressed on the shaft, keyed and secured by a circlip.

Reverse Gear.

Reverse gear is bushed and mounted on a short shaft pressed into the casing and supported at the inner end by a cast-in pillar. Phosphor-bronze thrust washers are fitted at each end of the gear (see Fig. 2).

LUBRICATION AND MAINTENANCE

The oil capacity of the gearbox is 9 pints. High grade gear oil should be used (see " Lubricants "), **never use grease.** Check the oil level weekly and replenish if necessary to the level of the filler.

Drain and clean out the gearbox every 20,000 to 25,000 miles and fill up with fresh oil.

If after a long period of operation, oil leakage occurs from the gearbox, renew the oil seal at the rear end of the mainshaft, see that all joints between the covers and the gearbox are in good condition and that the nuts are tight.

The small speedometer gearbox is provided with a nipple and should receive attention monthly, gear oil being used.

OVERHAUL

Removal and replacement of Gearbox.

Disconnect the speedometer drive and the propellor shaft at the front coupling ; swing the propellor shaft aside, take out the pin from the clutch rod connection and remove the bolts from the gearbox flange. Take the weight of the gearbox on a sling or blocks and draw the gearbox back until the clutch shaft is clear. **Do not take any weight on the clutch shaft.** Lower the gearbox to the ground.

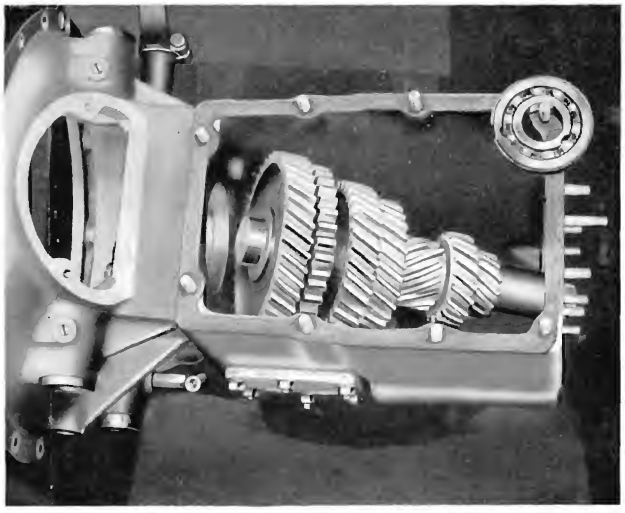


Fig. 5.
REMOVAL OF LAYSHAFT.

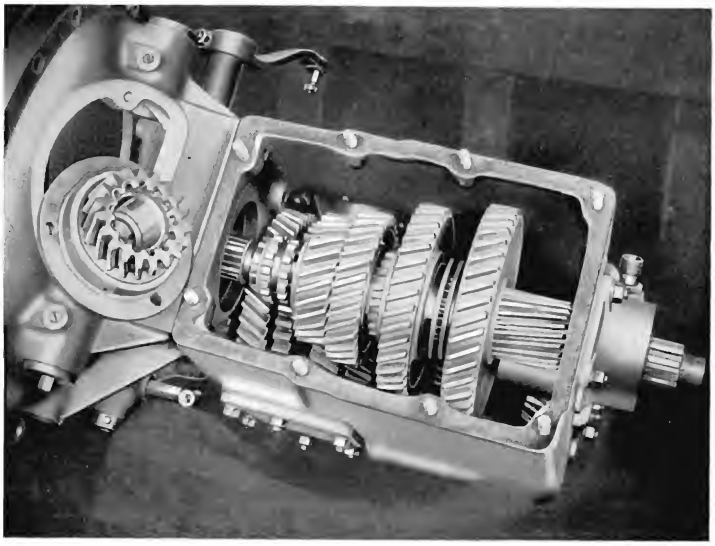
When replacing the gearbox, centralise the clutch plate with a dummy shaft (see " Clutch "), hoist the gearbox to the correct level and push it forward, engaging the clutch-shaft splines with the clutch-hub splines. **Care must be taken during replacement not to strain the clutch-shaft or clutch-plate.**

Dismantling the Gearbox.

Before dismantling the gearbox, remove the drain plug and drain out the oil. Remove the top selector cover from the gearbox.

Removal of Clutch-shaft.

Slack off the clamp bolts securing the toggle levers on the cross shaft, slide the toggle levers outwards as far as possible and remove the clutch withdrawal assembly. Take off the nuts securing the cover and remove the cover. Drive out the clutch-shaft and bearing from inside the gearbox. The bearing can be removed after extracting the circlip securing it on the shaft.



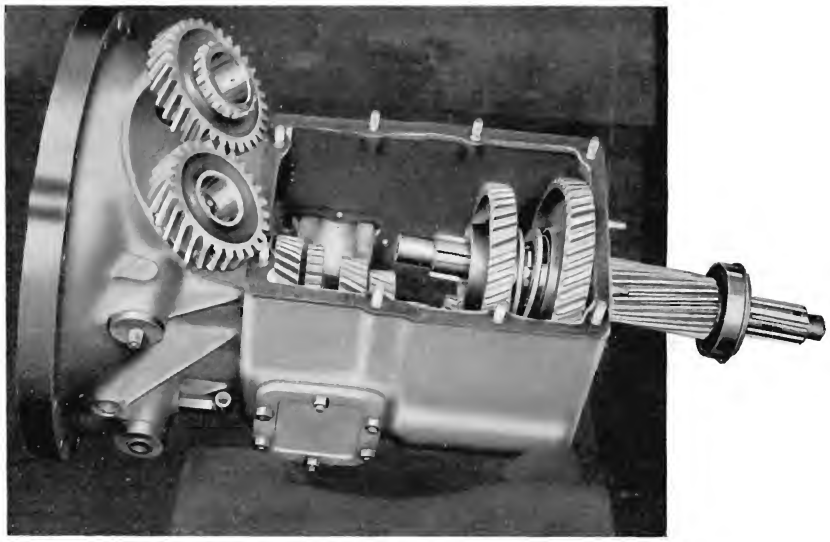
REMOVAL OF CLUTCH SHAFT.
Fig. 6.

Removal of Mainshaft.

Take off the nut securing the coupling flange and withdraw the flange. Take off the rear cover and remove the speedometer gear. Drive the mainshaft through from the front until the rear bearing is clear of the casing as shown in Fig. 6, and draw the bearing off the shaft; withdraw the mainshaft assembly through the top of the gearbox.

First and second gears will slip off the splines but the circlips and thrust washers shown in Fig. 3 must be removed before fourth and third gears can be withdrawn. An alternative method is first to remove fourth and third gears as shown.

REMOVAL OF MAINSHAFT.



Removal of Reverse Gear.

Remove the layshaft-rear-bearing cover and drive out reverse-gear shaft from the front end. Extract the rear thrust washer and lift the gear out. The bushes are pressed in from either end and should be replaced if they have undue play on the shaft.

Removal of Layshaft.

Remove the two setscrews and the bearing retainer (46), Fig. 1. Insert a pinch bar between layshaft drive gear and the front of the box and lever the layshaft back

GEARBOX

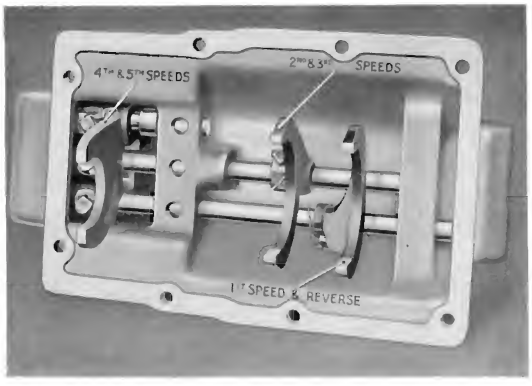
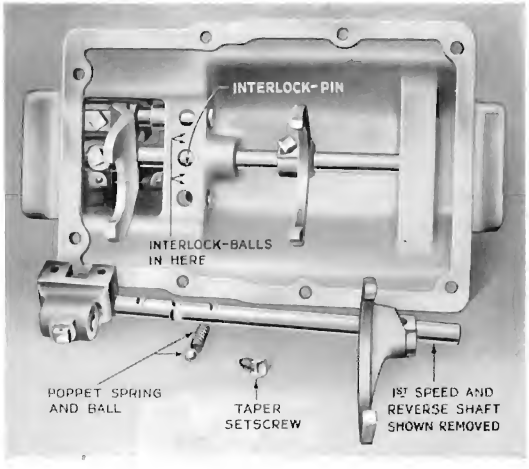


Fig. 7.
REMOVAL OF SELECTOR SHAFTS.



until the bearing is clear of the casing. If much pressure is required, tap round the bearing outer race with a drift. Draw the bearing off the shaft, push the layshaft back to clear the front bearing and lift out as shown in Fig. 5.

To remove the front bearing the detachable bell housing must be removed from the gearbox and the bearing then withdrawn.

Reassembling Gearbox.

The gearbox can be reassembled in the reverse order to dismantling.

If any layshaft gears require removing, these must be pressed off the shaft and the new ones pressed on, not omitting the keys.

Insert the layshaft front bearing from inside the gearbox. Slip the bearing washer (32), Fig. 4, on the layshaft and feed the layshaft, tail first, into the box and through the rear end until the front end can be inserted in the bearing. Insert the rear bearing and tap home till flush with the case, then replace the bearing retainer (46), tighten the two setscrews and wire them together.

Replacing Reverse Gear.

Stick the front thrust washer shown in Fig. 2, on the front of reverse gear with grease, so that the holes in the washer and gear register. Place the gear in the box and drop in the rear thrust washer between the gear and the casing, working the gear and thrust washer so that they line up and allow the shaft to be slipped through from the rear.

Make sure that reverse shaft is replaced with the slot towards the layshaft so that it can be locked with the bearing cover. Replace the layshaft bearing cover.

Replacing Mainshaft.

Assemble all gears on the mainshaft as shown in Fig. 1, locking third and fourth gears with the thrust washers and circlips. Insert the mainshaft assembly in the gearbox and tap in the rear bearing. Replace speedometer gear, then fit the cover and joint, taking care not to damage the oil seal (see " Maintenance and Docking ").

Replacement of Clutch-shaft.

Press the bearing on the shaft and lock with the circlip. Slip the spigot bearing into the gear and replace the dog (29), Fig. 4, on the mainshaft. Replace the clutch-shaft and feed the front end of the mainshaft into the spigot bearing. **The sliding dog (29) must be replaced with the recessed face to the back of the gearbox.**

Replace the front bearing cover and wire the setscrews together. Slip the clutch withdrawal assembly on the shaft, slide back the toggle levers and lock by tightening the clamp bolts.

SELECTOR GEAR

The selector gear is mounted in the top cover of the gearbox. The selector shafts are locked by means of spring-loaded balls which locate in slots in the shafts. The interlock device consists of a short pin housed in the second and third speed selector shaft, on either side of which are two balls which, when one shaft is moved to engage a gear, lock the other two shafts together.

Removal of Selector Shaft.

Remove the change-speed lever by taking out the four nuts securing it to the tower.

Take out the taper setscrews securing the selector forks shown in Fig. 7, and brackets to the shafts and drive out first and reverse shaft. Care must be taken not to lose the locking-ball and the two interlock-balls as the shaft is withdrawn. Extract the interlock pin from second and third speed shaft and withdraw the shaft. Collect the other two interlock balls and withdraw the fourth and fifth speed shaft.

Replacing Selector Shafts.

Drop the three poppet springs into the cavities and insert first and reverse-gear shaft. Thread on the bracket, place the locking-ball on the spring, push the shaft home and thread on the selector forks, locking both fork and bracket with the taper setscrews.

Insert two interlock-balls and replace second and third speed shaft, threading on bracket, replacing locking-ball and fork. Insert the interlock pin through the hole in the shaft.

Replace two more interlock-balls and push in the short selector shaft, through the fork and distance piece and over the locking-ball.

Tighten the taper setscrews and wire them to the forks and brackets. Replace the plugs in the selector-shaft holes.

Change Speed Lever.

The selector arm operates in a spherical housing secured to the tower, a steel ball being pinned to the arm itself. The arm is secured in the housing by a spring and cap.

To remove the lever, take out the cotter bolt and the lever will come apart from the selector arm.

To remove the selector arm, compress the spring, extract the split retaining-collar and withdraw the selector arm.

When replacing the selector cover on the gearbox, make sure that the joint is in good condition and oil tight.

Do not forget to refill the gearbox with oil after overhauling.

SECTION 13B

INDEX

GENERAL DESCRIPTION

The transmission system incorporates tubular propeller shafts with Layrub resilient couplings. The centre bearing is spherically seated in a housing mounted on a frame cross-member. The shafts and couplings are dynamically balanced before assembly so that the transmission system is immune from vibration.

The couplings consist simply of resilient inserts (*A*), Fig. 1, of compressed rubber contained in twin housings (*B*) clamped together by five bolts (*C*). The couplings and propeller shafts are connected by bolts (*D*).

LUBRICATION AND MAINTENANCE

The centre bearing should be lubricated weekly through the nipple provided in the chassis battery, using gear oil. The couplings do not require any lubrication and any surplus oil flung on to them should be wiped off periodically. Check monthly that all bolts are tight.

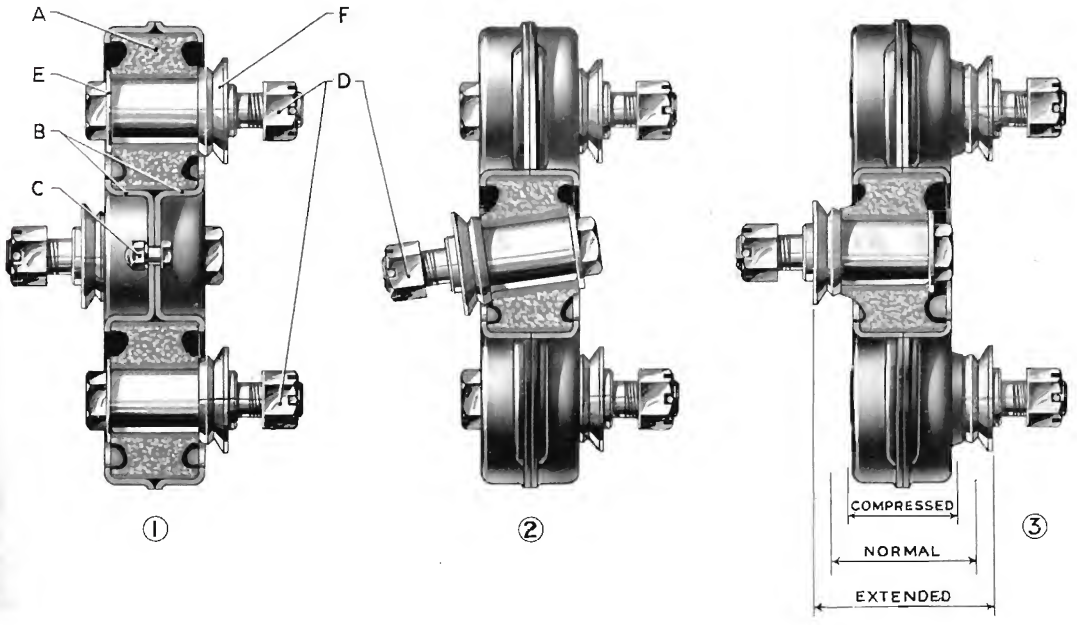


Fig. 1.
ARRANGEMENT OF COUPLING.

TRANSMISSION

OVERHAUL

When Removing Gearbox.

To swing the front propeller shaft aside when removing the gearbox, uncouple the front coupling from the gearbox flange, by removing the bolts (*D*), Fig. 1, slacken the four centre-bearing clamp-screws, release the lubrication pipe and unscrew the dowel locating the housing on the cross-member. The centre-bearing housing can then be moved along the cross-member until the shaft is clear of the gearbox and the front end slung conveniently. **Do not allow the shaft to hang from the centre-bearing.**

Removal of Propeller Shafts.

Before removing the front propeller shaft, the rear shaft must be removed. In all cases this can be disconnected at the flanges and lifted clear.

To remove the front shaft, take out the four centre-bearing clamp-screws and remove the cap, release the lubrication pipe, disconnect the front coupling at the gearbox flange and lift out the shaft and centre-bearing together.

Dismantling Centre-Bearing.

Remove the propeller shafts as outlined above, take off the flange retaining nut (*D*), Fig. 2, and slip the flange off the splines. The inner race is a push fit on the shaft and is locked by pulling the flange up against a distance sleeve (*E*).

Take off the nuts (*F*), Fig 2, and remove the cover (*G*), the ball-race (*H*) can then be knocked out of the housing in which it is a press fit.

Oil loss is prevented by leather oil seals (*J*), which are riveted to the housing and cover. These should be renewed if oil leakage is apparent.

If the bearing is to be renewed, knock the old bearing out of the housing and press in the new one.

Re-assembling Centre-Bearing.

Replace the bearing and housing on the shaft, taking care not to damage the oil seal, pack with grease and replace the cover. Slip on the distance sleeve (*E*), fit the flange on the splines and tighten the nut (*D*) hard, locking with the split pin. When replacing the centre-bearing on the cross-member make sure the dowel-screw is in position and do not forget to connect up the lubrication pipe.

Layrub Couplings.

To remove the couplings, take out the four bolts (*D*), Fig. 1, the couplings may then be dismantled by removing the five clamping bolts (*C*). If the resilient inserts (*A*) require renewal, the complete coupling should be returned to Leyland Service Depot

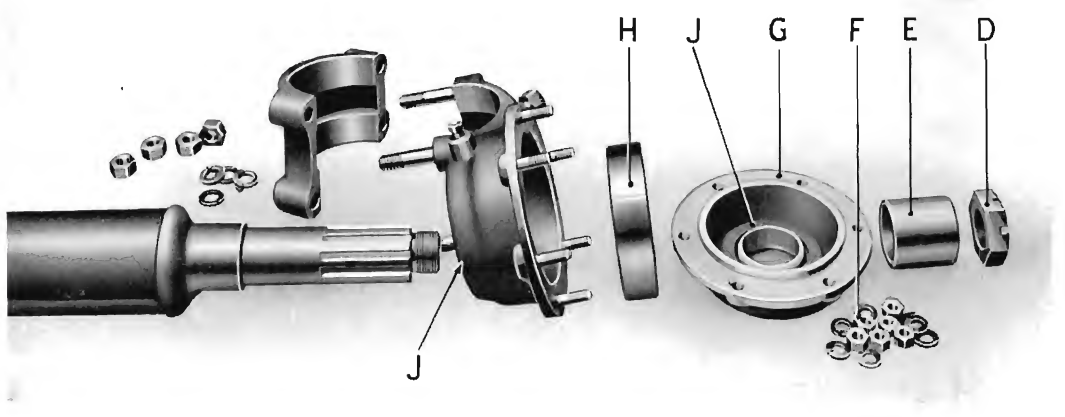


Fig. 2.
DISMANTLING CENTRE BEARING.

and exchanged for a service coupling.

When re-assembling the couplings, it should be noted that the washers (*E*) have one edge radiused. The washers must be replaced under the head of the bolts (*D*) as shown in Fig. 1, **with the radiused edge up against the rubber insert.**

The collar (*F*) abuts against the connecting flange and must be replaced with the spigot side to the flange.

The bolts (D) must be pulled up dead tight and split-pinned. This is most important.

Finally check that the five clamping bolts (*C*) are tight.

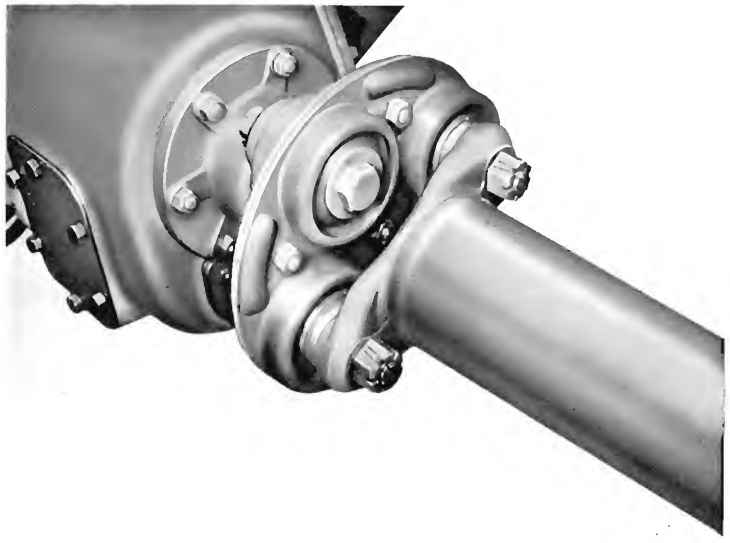


Fig. 3.
COUPLING IN POSITION.

REAR AXLE

SECTION 14A

INDEX

REAR AXLE

GENERAL DESCRIPTION

The rear axle is of the fully floating worm type with the worm wheel carried on roller bearings and adjustable sideways so that worm and wheel can be correctly aligned when re-assembling. The worm shaft is carried in a ball bearing at the front end, the thrust being taken at the rear end by large double-purpose taper roller bearings. Oil loss is prevented by leather oil seals on the axle shafts and a packless gland on the front end of the worm shafts.

Taper roller bearings are used in the hubs which can be left undisturbed while removing the brake drums and shoes. Leather oil seals prevent the leakage of grease from the hubs to the brake shoes.

All parts of the axle can be removed for overhaul or repair without detaching the axle casing from the chassis.

On passenger machines the axle has underslung worm gear, whilst on goods machines the worm gear is overhead.

The following axle ratios are used :—5.5, 6.5 and 7.5 to 1. The ratio for this machine is stamped on the worm carrier.

LUBRICATION

Use only a high-grade gear oil having the specification stated under " Lubricants." Regular lubrication is essential for economic operation and a supply of gear oil, unless other lubricant is stated, should be given to the undermentioned points as follows :—

1. **Worm Gear.**—Capacity of axle pot, one gallon. Check the oil level weekly and fill up to the level of the filler spout; see that the oil is not air locked but is actually up to the level. It is good policy to drain off the oil and refill with fresh oil after the first 5,000 miles. This is most conveniently done after a run, while the oil is warm.
2. **Wheel Hubs.**—Remove the hub caps when docking (7,000-10,000 miles) and replenish the hubs with grease if necessary. The hubs are packed with grease while assembling and should be repacked whenever the hubs have been removed. Over lubrication may result in some surplus grease reaching the brake shoes.
3. **Brake Camshafts.**—Weekly through the nipples on the rear axle battery. Limited supply nipples are provided for the inside bearing, one stroke only of the gun is required.

GENERAL MAINTENANCE

Check the play in the hub bearings after the first 5,000 miles and afterwards at longer intervals. There should be approximately .005 in. play in the bearings and this must not be allowed to become excessive.

Adjust as outlined under " Adjustment of Hub Bearings." Tighten the nuts round the worm carrier flange after 2,000 miles and check periodically to avoid oil leakage. Check frequently that the spring clip nuts are dead tight (see " Road Springs ").

REAR AXLE

ADJUSTMENT AND OVERHAUL

Withdrawal of Axle Shafts.

Remove the nuts from the studs (*B*), Fig. 1, and draw off the hub cap by screwing jacking bolts into the tapped holes provided ; the axle shaft can then be withdrawn. When replacing the hub cap make sure that the joint is in good condition and that the nuts on studs (*B*) are hammered tight. **They must not be just hand tight.**

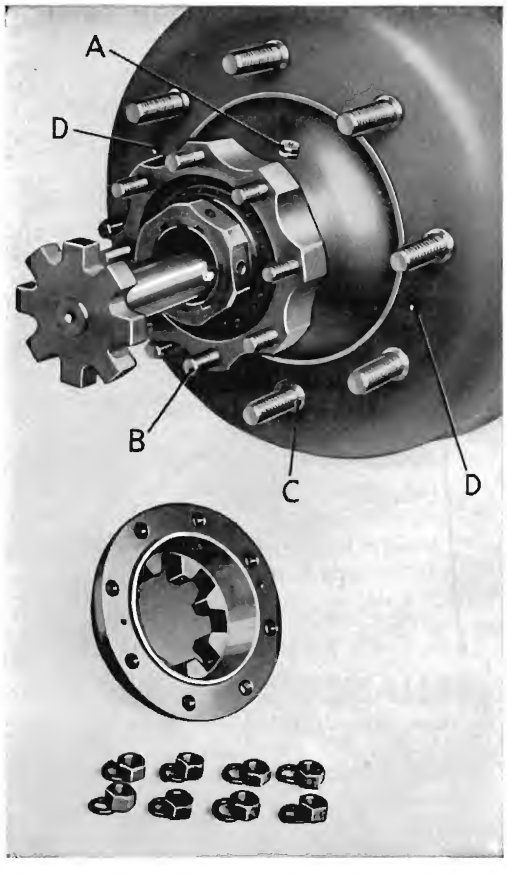


Fig. 1.
Withdrawal of Axle Shaft.

Adjustment of Hub Bearings.

The taper roller bearings (*E*), Fig. 2, on which the hubs rotate are mounted on the axle tube, play in the bearings is determined by the thickness of shims (*F*) fitted on the end of the distance piece (*G*). To adjust for end play insert suitable shims (available in three thicknesses) until the end play is approximately .005 in. when the locking nut (*H*) is tightened solid. This nut has six positions for locking with the locking bolt (*J*) and four thicknesses of washer (*K*) are available further to facilitate finding the correct position for inserting the locking bolt. **It is important that the nut (H) be hammered up solid, on no account must it be slackened back to insert the locking bolt.**

When correctly adjusted the hub should rotate freely and have end play not exceeding .005 in. Make sure that the locking bolt (*J*) is split-pinned and the hub filled with grease before fitting the hub cap.

Removal of Hubs.

Jack up the axle, remove the road wheels, draw the axle shafts and remove the brake drums. The drums and wheels are supported on conical washers (*C*), Fig. 1, on the wheel studs, these washers can be withdrawn when removing the drum by screwing $\frac{3}{8}$ in. B.S.F. setscrews into the tapped holes (*D*). Remove the locking bolt (*J*), Fig. 2, and unscrew the nut (*H*). Draw off the hub together with the front bearing and outer race of the rear bearing. If new bearings are required the outer races can be knocked out of the hub and the new ones pressed in, the inner races are an easy fit on the axle tube. Renew the oil seal (*L*) complete if grease is reaching the drums or the seal is damaged.

Carefully adjust for end play when assembling.

Brake Shoes and Camshafts.

For removal and other instructions see "Brakes."

Removal of Worm Carrier.

Draw the axle shafts, disconnect the rear Spicer coupling at the flange and remove the nuts from the studs (*M*), Fig. 3. The assembly can now easily be lifted clear of the casing by means of a sling. In the case of underslung axles the worm carrier should be jacked up while the nuts are removed and then lowered on the jack.

Adjustment of Worm Shaft.

Endwise adjustment is effected by fitting shims at (*A*), Fig. 5, between the bearing-housing flange and the cover; three thicknesses of shims are available.

It is important that end play of at least .007 ins. be allowed in the thrust bearing (B). The correct clearance can be obtained by fitting shims so that the shaft can just be turned by hand when the cover is tightened. The addition of one shim .010 in. thick will then give the desired clearance. This adjustment can best be carried out with the front bearing housing removed and the bearings in a clean dry condition.

Adjustment of Differential Side Bearings.

The roller bearings (*C*) Fig. 5, are carried in bearings cups (*D*) which are split so that they nip the races when the caps (*E*) are pulled down. Dowels locate the cups in the housing so that the cups cannot rotate when the adjusting nuts (*F*) are turned. The adjusting nuts are secured by locking plates fastened to the caps by setscrews (*G*).

End play of .008 in. should be allowed in the bearings, undue clearance results in a noisy axle and excessive wear on the worm wheel. Adjustments should be made on the left hand (near side) bearing which does not alter alignment of worm and wheel; the right hand bearing should only be disturbed when dismantling for overhaul or renewal.

Removal of Worm Wheel.

Take off the nuts (*T*), Fig. 7, and the bearing caps (*E*) and lift the differential assembly clear, the bearing cups with outer races and adjusting nuts can then be removed.

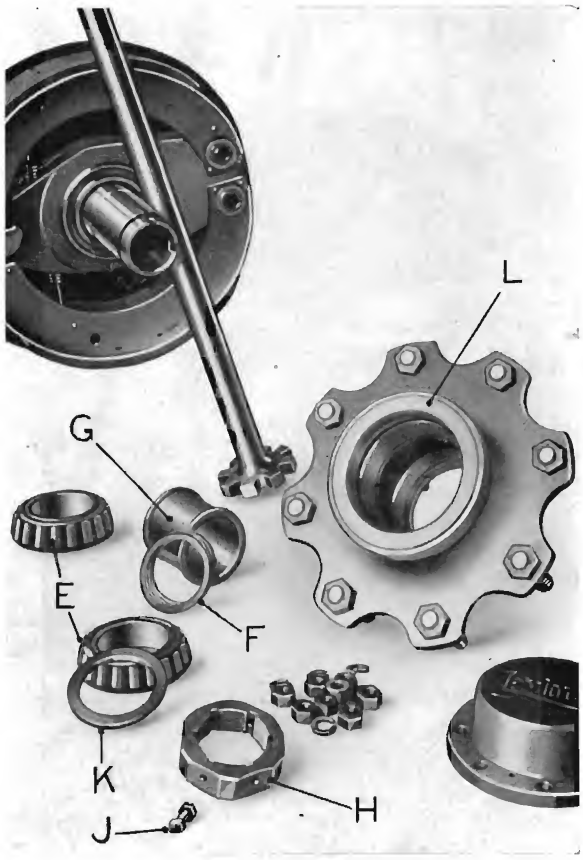


Fig. 2.
Adjustment of Hub Bearings.

The halves of the differential cage are fitted in the worm wheel on spigots, the whole being securely bolted together by alloy steel bolts fitted in reamed holes; the nuts and bolt heads are wired together. The cages can be removed by taking off the nuts, drawing out the bolts (*U*) and screwing two of the bolts into the tapped holes (*V*) provided to draw the cages from the wheel. The differential pinions are carried on a trunnion (*Q*), Fig. 6, which takes its bearings in the cage and also provides a bearing for the side pinions (*R*). Detachable, bronze wearing washers (*S*) are fitted behind the pinions (*R*) and a spacing washer is fitted between them.

REAR AXLE

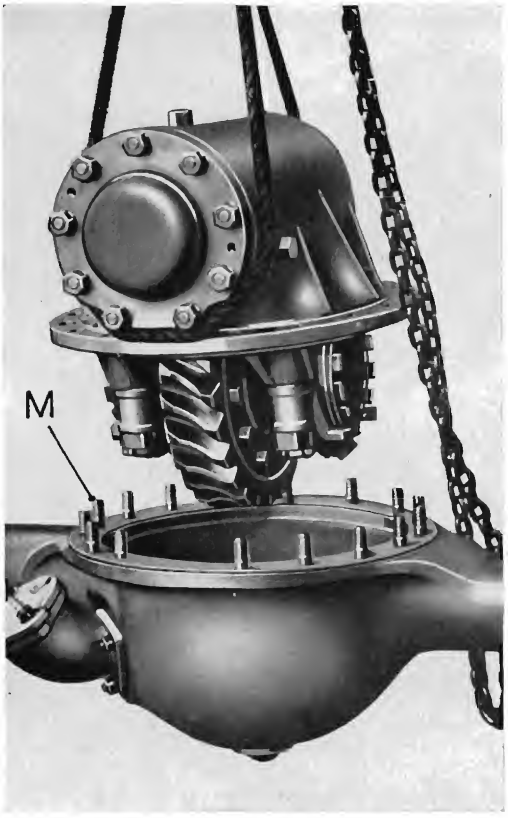


Fig. 3.
Removal of Overhead Worm Gear.

Reassembling Differential.

Before reassembling check that all the differential pinions are undamaged and are not unduly worn, new ones should be fitted if required. Inspect the wearing washers and spacing washer for wear renewing if called for. If the bearings are to be renewed the inner races can be detached from the cages by inserting a small bar in the holes drilled through the cages behind the bearings and tapping the races off the cages.

Care must be taken when rebuilding to replace the wearing washers and spacing washers in their correct positions. The faces of the spigot joints should be quite clean before fitting together. Tighten the 12 bolts hard and evenly, then wire together both the bolt heads and the nuts.

Removal of Worm Shaft.

Draw off the coupling flange, release the tab washer and unscrew the nut (*H*), Fig. 5 ; take off the rear cover (*J*), tapped holes are provided for drawing. Screw two bolts into the tapped holes in the thrust race housing flange and draw the shaft through complete with the front bearing.

If the bearings are to be renewed, the thrust race can easily be removed after taking off the nut (*K*). Two recesses (*L*), Fig. 6, are provided in the shoulder on the worm shaft so that a bar can be used to tap off the races. When the nut (*K*) is replaced it must be tightened solid and locked with the tab washer.

When refitting the shaft, all the bearings and rear housing should be assembled on the shaft which can then be inserted from the rear end, the front bearing housing should not be fitted until after adjustment. Adjust

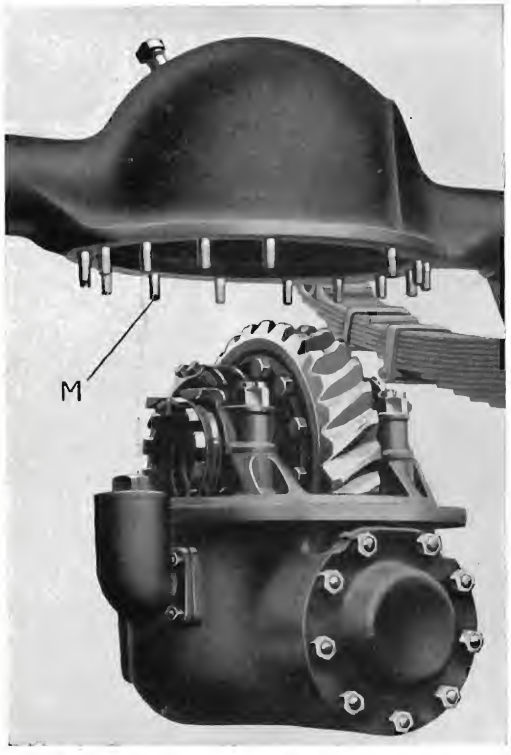


Fig. 4.
Removal of Underslung Worm Gear.

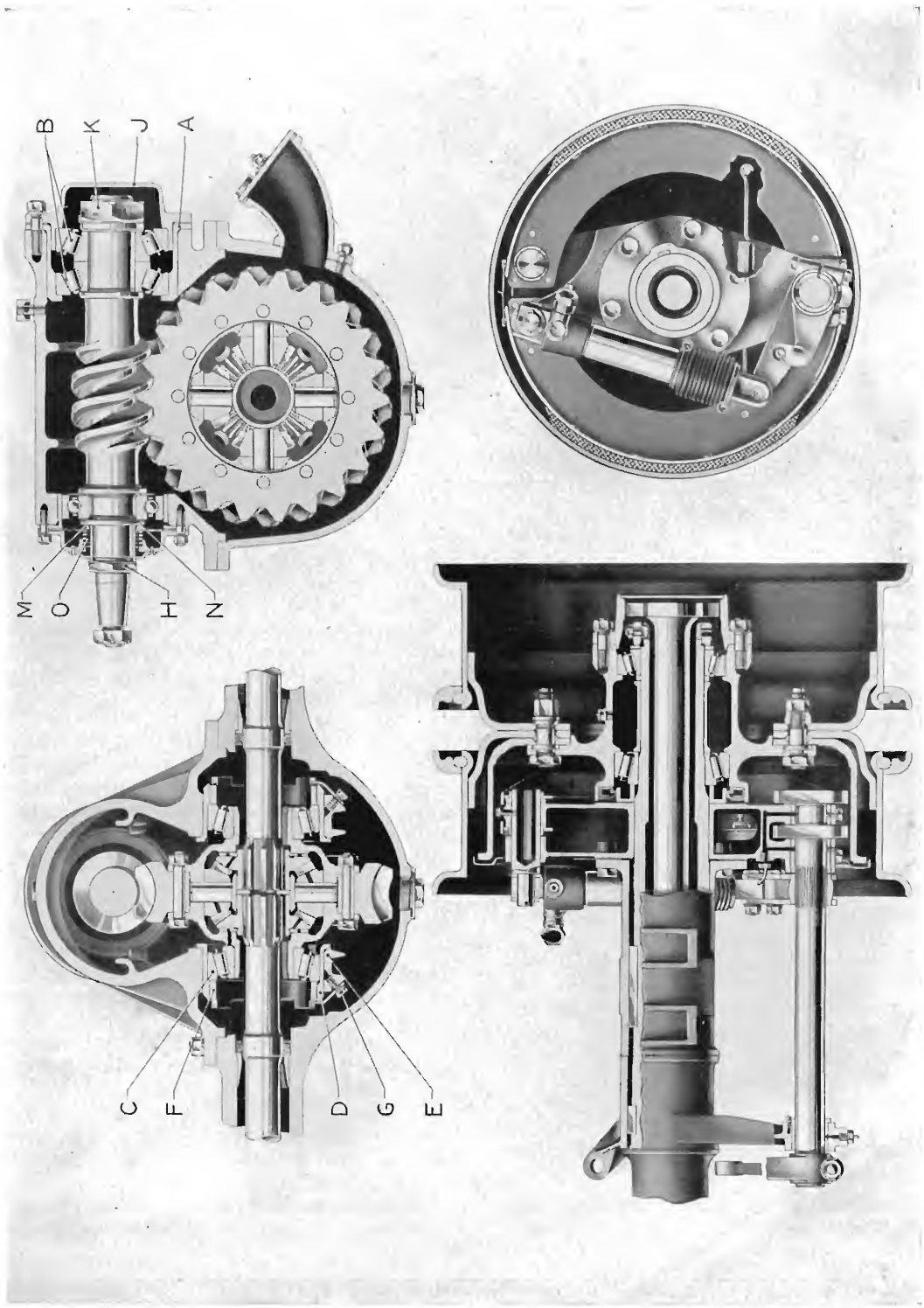


Fig. 5.
Arrangement of Rear Axle (Overhead Worm Gear).

REAR AXLE

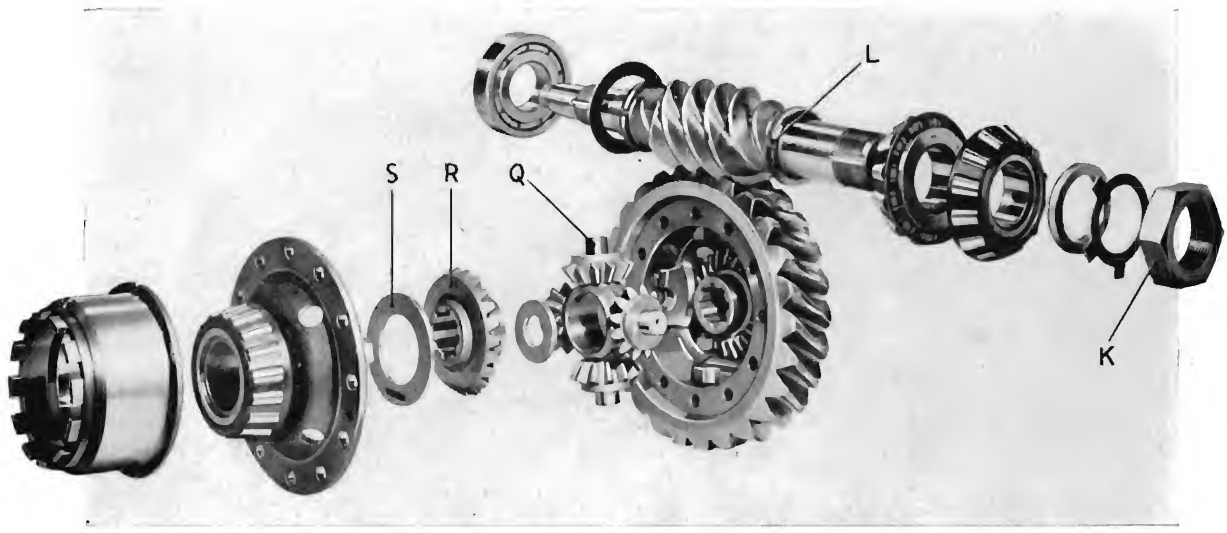


Fig. 6.
Worm Gear Assembly.

for end play of .007 in. as outlined under "Adjustment of Worm Shaft," the front bearing housing can then be replaced, the gland assembled and the locking nut (*H*), Fig. 5, tightened solid and locked with the tab washer. The Spicer coupling flange must then be carefully fitted, see "Taper Fixings."

Worm Shaft Gland.

Oil loss along the worm shaft is prevented by means of a packless gland fitted on the front end of the shaft. The gland consists of a thin diaphragm having a bronze seating ring (*M*), Fig. 5, attached to the inner end. The necessary pressure against the seating washer (*N*) is supplied by the spring (*O*). The gland requires no adjustment but care should be taken when dismantling not to damage the bronze seat. If the seat is damaged a complete new gland should be fitted.

Adjustment of Worm and Wheel (after Overhaul or Renewal).

When re-assembling after overhaul, the worm and wheel must be correctly aligned and the differential bearings adjusted. Have all parts perfectly clean, fit the worm shaft and adjust for end play. Coat the worm with a thin layer of marking blue and place the differential assembly in position; tighten the nuts (*T*), Fig. 7, so that the caps (*E*) barely nip the cups (*D*) on the outer races. Screw up both adjusting nuts (*F*) until there is no play in the bearings then align the worm and wheel by adjusting both nuts. Slack off each nut one notch and rotate the worm shaft in the direction of arrow in Fig. 6, keeping a load on the worm wheel so as to obtain a good marking. Fig. 7 shows the appearance of the worm wheel when correctly aligned; the driving face of the tooth should show a marking of from one-half to three-quarters the width of the tooth on the leaving side. **The entering side should not show marking;** the contact will be central when under load.

If the worm shaft is turned in the opposite direction the marking will show on the opposite side of the tooth on the opposite hand.

When alignment is correct check for end play (see "Adjustment of Differential Bear-

ings "), tighten and pin the nuts (*T*), Fig. 7, and fix the locking plates (*W*). The setscrews (*G*) must be wired together.

On underslung worm axles the worm shaft should be rotated in the same direction as shown in Fig. 7. The marking will then appear on the other side of the tooth on the leaving side. This corresponds to driving the axle.

Replacing Worm Carrier.

Before replacing the worm gear in the axle casing check that the leather oil seals on the axle shafts are in good condition. These are mounted in aluminium sleeves located in the axle casing by dowel screws. The sleeves are a light tapping fit and can be withdrawn after removing the dowel screws.

When replacing the worm carrier see that the paper joint on the flange is not broken and check that the coupling flange is well home on the taper end of the shaft.

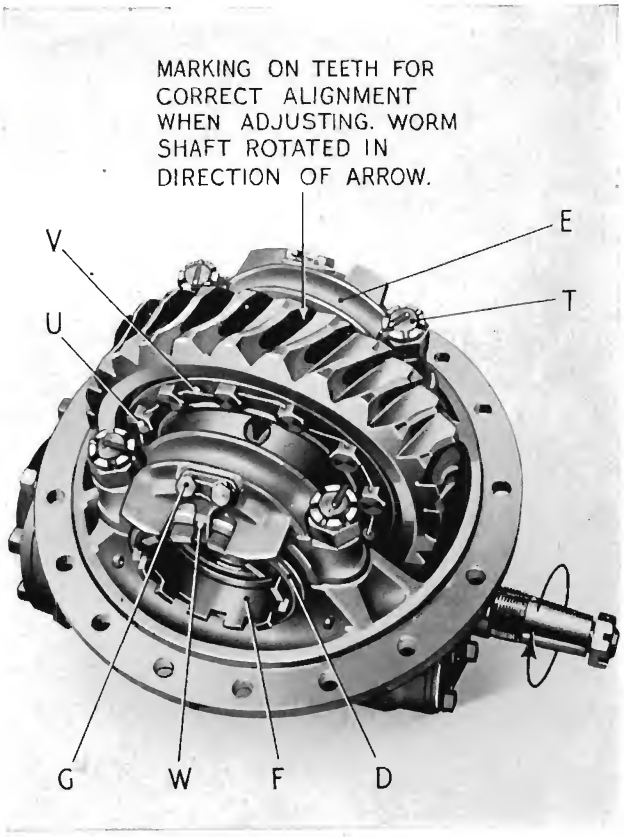


Fig. 7
Alignment of Worm and Wheel (Overhead Type).

Removal of Rear Axle.

The chassis should be well packed up both behind and in front of the rear axle to avoid excessive overhang. Disconnect the propeller shaft at the rear flange and sling the shaft to a convenient cross-member. Uncouple the brake operating ribbons and pipes, then jack up the axle and remove the road wheels. Remove the shackle pins (see "Removal of Road Springs") and the axle can be lowered to the ground and removed. Do not skid the axle on the brake dust covers, these should be kept clear of the ground.

FRONT AXLE

SECTION 15A

INDEX

GENERAL DESCRIPTION

The axle beam is a nickel steel forging of carefully designed section to take the strain imposed upon it by the front wheel brakes. The axle arms are of nickel steel and are carried on steel bushes, the thrust being taken on a thrust race at the top of the king pin. The brake expanders are fixed to the back plate between the shoes, the back plate also carrying the cams for adjustment of the brake shoes. Track rod and drag link are adjustable while the ball pins are located in hardened sockets, play being automatically taken up by a strong square section spring. Lubrication throughout is by means of nipples, leakage from the hubs to the brake drums being prevented by leather oil seals.

LUBRICATION AND MAINTENANCE

Fig. 2 shows the general arrangement of the axle. The lower king pin bush is lubricated through the nipple (*A*), the nipple (*B*) serving for both the top bush and the thrust race. A felt washer (*C*) prevents oil loss from the bottom bush. The hubs are packed with grease on assembly and should be repacked whenever the hubs are removed.

Lubricate regularly as stated below, gear oil being used unless otherwise specified.

Steering Ball Joints.—Daily through the nipples in the socket ends.

King Pin Bushes and Thrust Race.—Weekly through the nipples (*A*) and (*B*), Fig. 2.

Hub Bearings.—Remove the hub caps when docking (7,000-10,000 miles) and replenish the hubs with grease if necessary.

Excessive lubrication of the hubs tends to force grease past the oil seals (*D*), Fig. 2. In the event of grease reaching the drums, remove the hub and check that the **oil** seal is in good condition.

Check the hubs for end play after 5,000 miles and then at intervals of 10,000 miles ; adjust as outlined under " Adjustment of Hub Bearings."

Keep all road spring clips dead tight and also the nuts securing the steering arms to the axle arms.

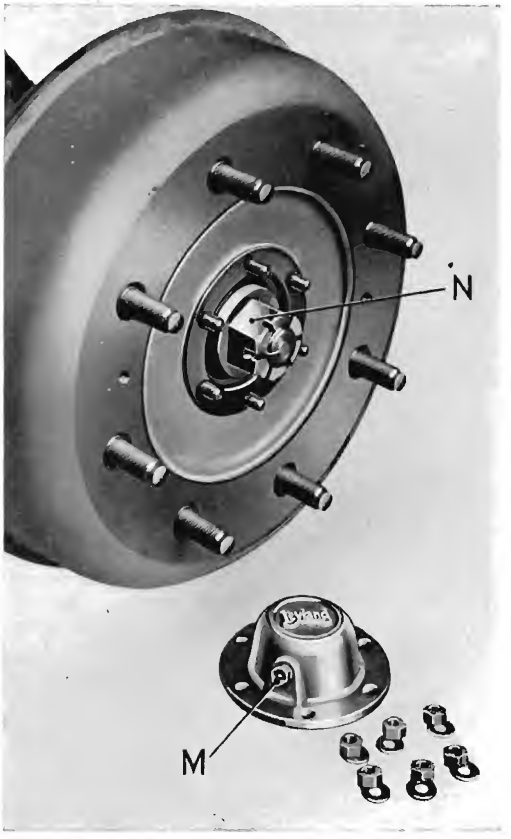


Fig. 1.
Adjustment of Bearings.

FRONT AXLE

ADJUSTMENT AND OVERHAUL

Adjustment of Hub Bearings.

The hubs are carried on taper roller bearings (*E*), Fig. 2, and these should be kept adjusted so that there is not more than .005 in. end play.

To adjust the bearings remove the hub caps as shown in Fig. 1. The nut (*N*) has six slots and the stub axle two holes at right angles so that there are twelve positions for locking the nut with the split pin. When re-assembling or adjusting screw up the nut (*N*) until the bearings are just tight, then slack back the nut till the nearest slot and hole are in line to insert the split pin.

Removal of Hubs.

The brake drums and shoes can be removed without disturbing the hubs (see " Brakes "). To remove the hub take off the hub cap and unscrew the nut (*N*), Fig. 1. The hub can then be drawn off bringing with it the outer roller bearing.

If the bearings are to be renewed the outer races can be knocked out of the hub. Before pressing home the new races check that the recesses are free from foreign matter which might prevent them going right home. Pack the hub with grease and adjust for end play as already outlined.

Removal of Axle Arm.

Disconnect the steering connections by slacking off the nuts (*F*), Fig. 2, a few turns and drawing the pins through the steering arms. A drawer is available for this purpose, a hammer should not be used as there is danger of distorting the steering arms. Uncouple the flexible brake pipes, the back plates and brake shoes need not be removed.

Take off the top and bottom covers (*G*) and (*H*) and unscrew the king pin nut (*J*); the thrust race (*K*) can then be removed. Remove the nut and drive the cotter (*L*) out towards the front, then drive out the king pin by striking the top with a lead hammer to avoid damaging the threads.

If the bushes are worn replace with new ones, a new king pin being fitted if the new bushes are too slack on the old pins.

To re-assemble drive the king pin in from below, care being taken to ensure that the slot for the cotter is in the correct position and that the felt washer (*C*) is replaced; the cotter must be inserted from the front.

Fit the thrust race if in good condition, replace if at all pitted and screw on the nut (*J*). This nut must on no account be tightened too hard, screw down tight and then slacken until the axle arm can just be rotated. Replace the covers and lubricate the bushes.

Steering Arm and Track Rod Connections

The steering drag link and track rod ends are one piece forgings screwed left and right on the rods for adjustment and locked with a nickel steel bolt (*A*), Fig. 3. These bolts must be kept tight and must not be replaced with mild steel bolts. Allowing the bolts to remain loose may result in serious damage to the adjusting threads.

The ball (*B*) is located between cups (*C*) and (*D*) and a heavy square-sectioned coil spring (*E*) is inserted between the cup (*D*) and the spring housing (*F*). The rod cannot come adrift in the event of the spring breaking as the slot in the steering rod end is less than the diameter of the ball.

Removal of Ball Pin.

Take off the nut (*G*) and release the ball pin from the taper in the steering arm; slack off the clamp bolt (*A*) and unscrew the steering rod end. Take out the cotter pin (*H*), unscrew the spring housing (*F*) and withdraw the ball cup (*C*). The ball pin can now be removed through the end of the socket.

When replacing, clean and grease thoroughly and observe that the hole in the ball pin is clear. Screw up the spring housing solid and then slack back half a turn to ensure that the ball is not nipped. Be sure that the clamp bolt (*A*) is well tightened and the nut split-pinned.

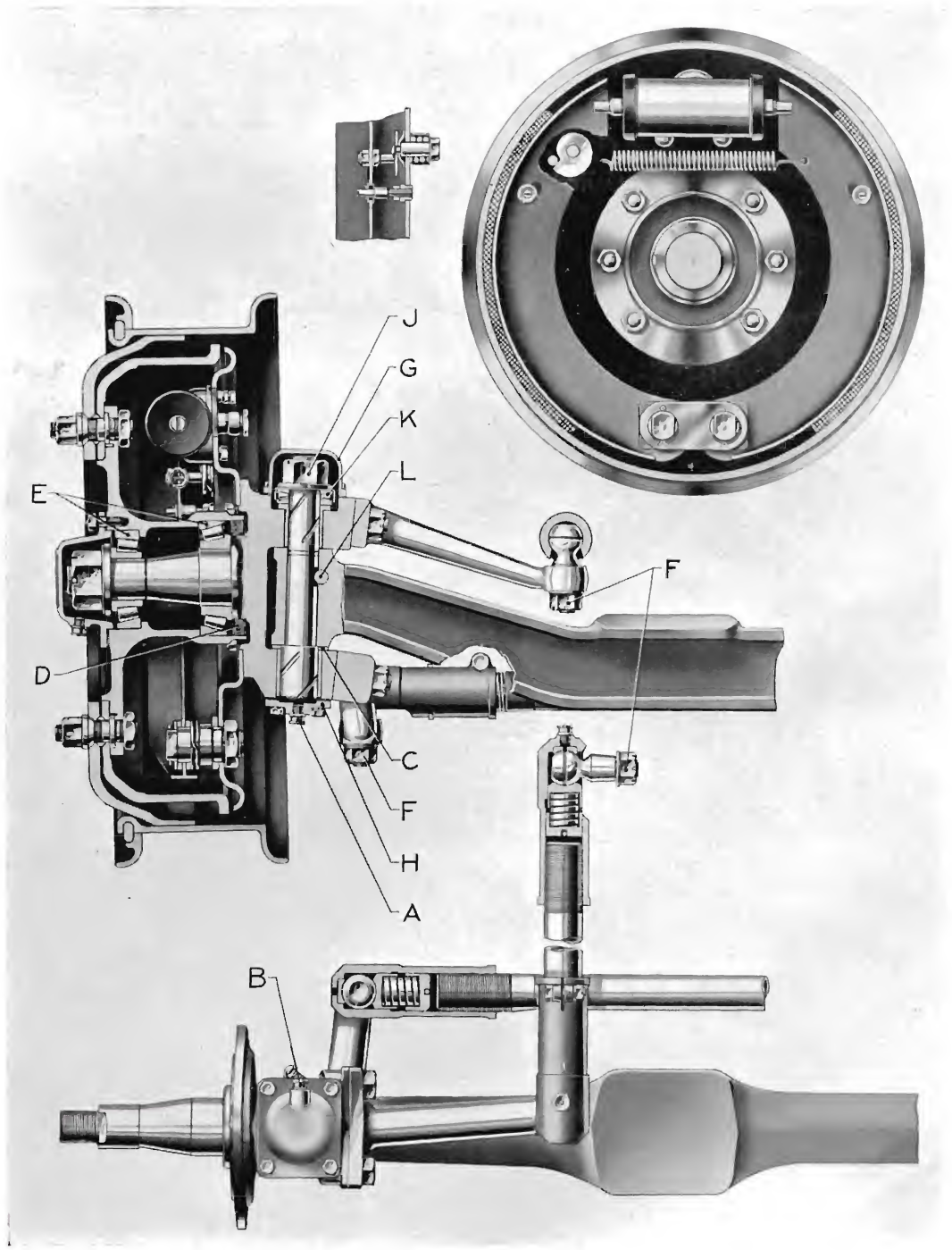


Fig. 2.
Arrangement of Front Axle.

FRONT AXLE

Track and Track Adjustment.

The wheels should be tracked up dead parallel. The track rod is screwed right and left hand so that when the clamp bolts are slackened the track rod can be turned as desired to obtain correct adjustment. Tighten and split pin the clamp bolts when the operation is completed.

Removal of Front Axle.

Pack up under the frame side members and disconnect the drag link by driving the pin from the steering arm. Release the brake hoses at the unions and remove the road spring clips; the axle can then be drawn clear.

When replacing, ensure that the road spring clips are tight; the nuts must be pulled up dead tight and split-pinned.

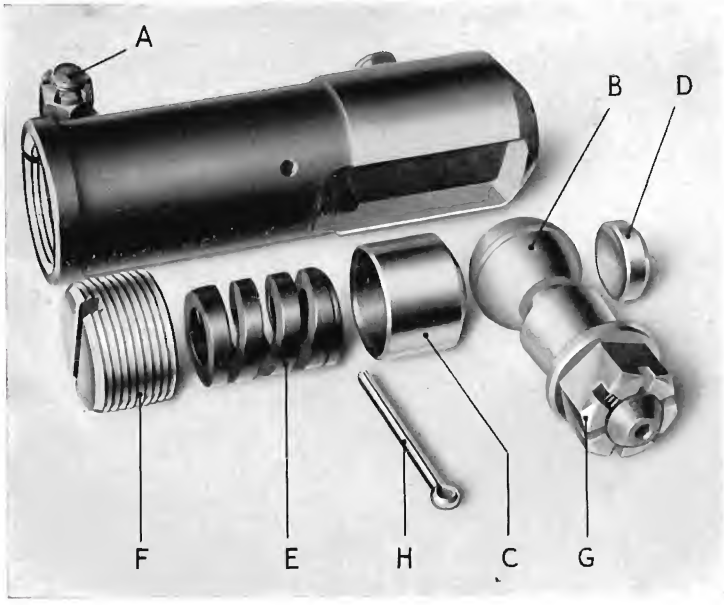


Fig. 3.

Track Rod Ball and Socket Joints.

SECTION 16A

INDEX

STEERING GEAR

GENERAL DESCRIPTION

The Marles type steering gear fitted as standard gives exceptionally easy steering and requires no attention beyond lubrication during long periods of service.

The drop arm (*A*), Fig. 2, is fitted on the serrated taper end of the rocker shaft (*B*), which is carried in bronze bushes (*C*), Fig. 1, the thrust being taken on a phosphor bronze bearing (*D*) secured in the casing by two retaining bolts (E). End play is taken up by means of an adjusting screw (W), Fig. 4. The fork (F), Fig. 2, is formed integral with the rocker shaft and carries a case-hardened roller (G) which rotates on roller bearings mounted on an adjustable pin (H). The roller engages with a cam track formed on a hardened sleeve (J) keyed on the tubular steering shaft and mounted on roller bearings (K). The steering wheel is keyed on the upper extremity of the steering shaft and the assembly is mounted in a robust trunnion bolted to the frame side-member.

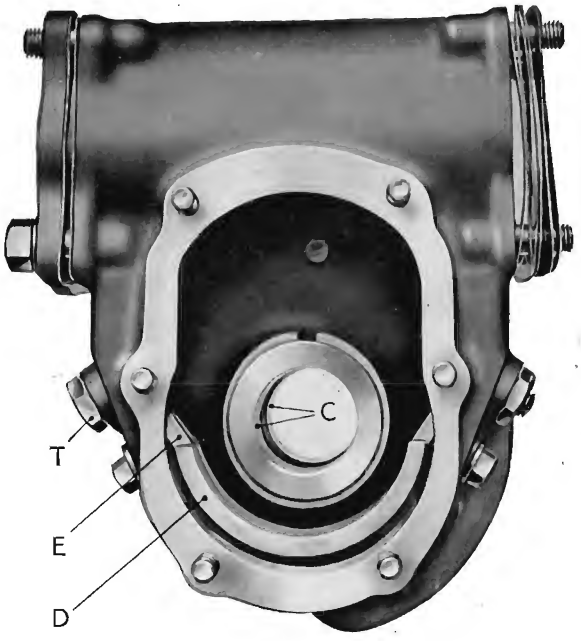


Fig. 1.
Steering Box Bearings.

LUBRICATION

The steering box is filled with gear oil on assembly by means of the large diameter screwed plug. A nipple is provided for replenishment purposes. A separate nipple is provided for lubrication of the rocker shaft bushes. The drag link ball joints are lubricated by means of nipples in the sockets.

Lubricate with gear oil as follows:—

1. **Drag Link Ball Joints.**—Daily through the nipples in the sockets.
2. **Steering Box.**—Weekly through the nipple.
3. **Rocker Shaft Bushes.**—Weekly through the nipple in the front chassis battery.

ADJUSTMENT AND OVERHAUL

Removal of Steering Gear.

Disconnect all controls and the lubrication pipe. Remove the ball pin from the drop arm (a drawer is available, do not use a hammer). Remove the nut (O), Fig. 3, from the end of the rocker-shaft and draw the drop-arm off the taper. (Note that the rocker-shaft and drop-arm are clearly marked to show the correct position of the latter when replacing.) Take off the nuts (*P*) securing the steering box to the trunnion bracket and the assembly can be removed.

Dismantling Steering Gear.

No attention beyond lubrication should be required until general overhaul time, when

STEERING GEAR

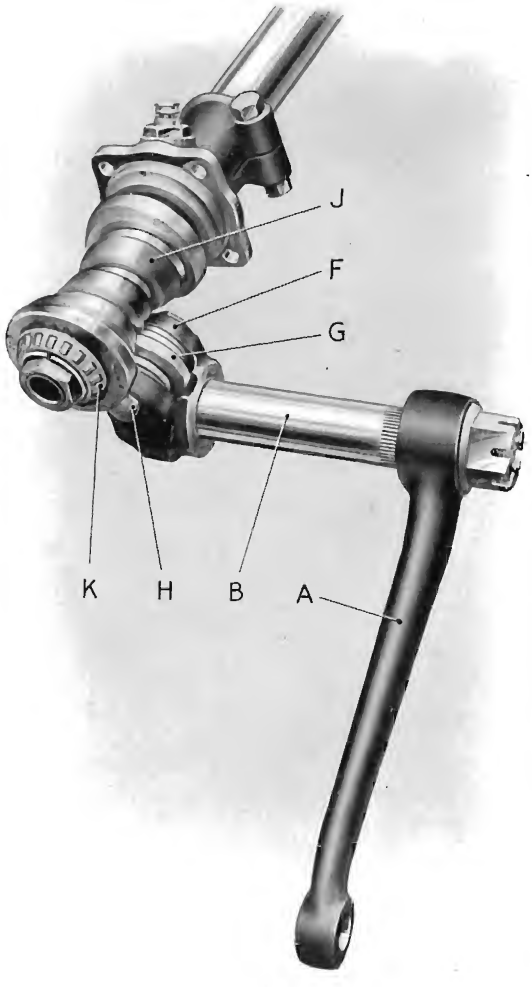


Fig. 2.
Steering Gear Mounting.

the gear should be stripped and all parts examined for wear.

To remove the rocker-shaft, take off the cover (*Q*), Fig. 4, and the rocker-shaft can be withdrawn. Remove the nuts (R) and the steering-shaft and cam can be withdrawn as shown in Fig. 5.

Before re-assembling check that there is not excessive play in the rocker-shaft bushes ; this should not exceed .005 in. If the bearing (*D*) ,Fig. 1, is worn it can be removed by taking out the two bolts (*E*) and a new bearing fitted. See that the felt washer on the rocker shaft is in good condition.

The cam (*J*), Fig. 2, is keyed on the shaft and secured by a large nut. When replacing ensure that the key is a good fit in both keyways and that the cam is a driving fit on the shaft. Tighten the nut and lock by burring over the thread in two places with a centre punch.

See that all parts are greased and that all nuts are securely locked. The drop-arm should be thoroughly cleaned, polished and examined before replacing.

Adjustment.

No adjustment should be required during normal service, but after overhaul careful adjustment is essential. For efficient operation the following four conditions must be satisfied :—

1. The cam should rotate freely on the roller bearings but should have no end-play.
2. The arc described by the rocker-shaft (*B*), Fig. 2, should coincide with the

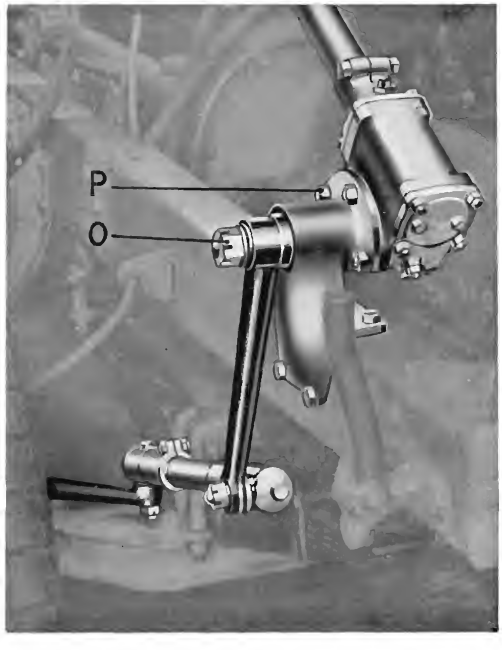


Fig. 3.
Steering Gear Mounting.

arc of the cam in which the track is cut, thus ensuring constant mesh of roller and cam.

3. The mesh of the roller with the cam-track should be such that when the roller is in the mid-position there is no backlash.
4. The lock-stops (*T*), Fig. 1, in the steering box should be set so that the roller can never reach the end of the cam by a quarter of a turn.

To satisfy these conditions four adjustments are necessary, namely :—

1. Adjustment of cam bearings.
2. Adjustment of cam in relation to rocker-shaft roller.
3. Adjustment of mesh between roller and cam.
4. Adjustment for travel of rocker-shaft.

Adjustment No. 1.

Fit the bottom cap (*U*), Fig. 5, and the cam and steering-shaft ; adjustment for end play is effected by means of shims (*V*) of varying thickness. End play is taken up by removing shims ; adjust until there is no end play with all nuts tightened, but the shaft will rotate freely.

Adjustment No. 2.

Set the roller in the mid-position of the cam without backlash. It is possible to be a quarter turn out from mid-position and appear correct ; the roller will be engaging with mid-position on the cam when the cam keyway is opposite to the roller. To assist in finding this position the keyway for the steering wheel is machined in line with the keyway for the cam and can be found by removing the nut from the top of the steering column.

The keyway should be in a position corresponding to the front of the chassis if the steering gear were mounted.

It is of the utmost importance that the arc described by the rocker-shaft roller (*G*), Fig. 2, should coincide with the arc of the cam-track.

Replace the cover (*Q*), Fig. 4, and move the roller to the limit of travel in each direction, when the backlash should be equal at both ends, approximately .005 in. If this is not so the cam will bind at one extremity of its travel.

If binding occurs, remove one shim at a time from the opposite end and replace a shim of equal thickness at the other end to maintain adjustment. This should be carried out until backlash is equal at both extremes.

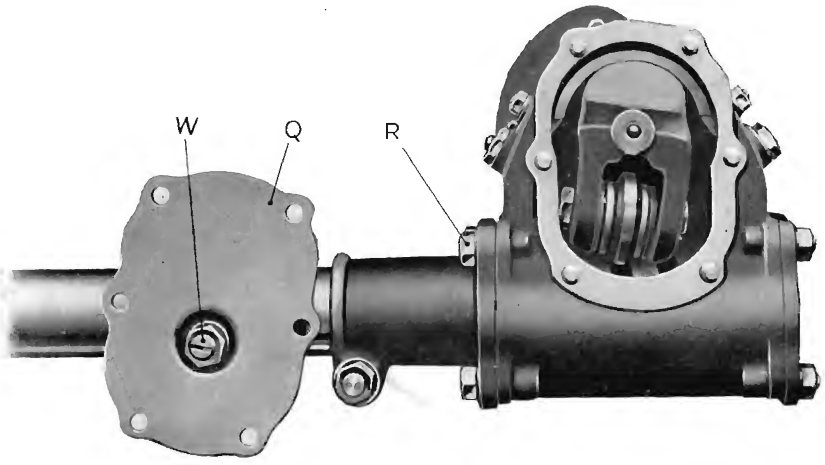


Fig. 4.
Dismantling Steering Gear.

Adjustment No. 3.

The roller and its bearings are mounted on a sleeve carried on a serrated pin (H). Fig. 2, the sleeve being eccentric with the pin. The serrations on the pin also engage in serrations in the fork, thus locking the pin after adjustment.

To adjust for mesh, remove the nut and tab washer and knock the pin through the fork far enough to clear the serrations in the fork. Turn the pin in a clockwise direction until the roller engages with the cam in the mid-position without any backlash and yet is free enough to be turned by the fingers. Knock the pin back through the fork, replace the locking washer and nut ; tighten the nut and lock with the locking washer.

STEERING GEAR

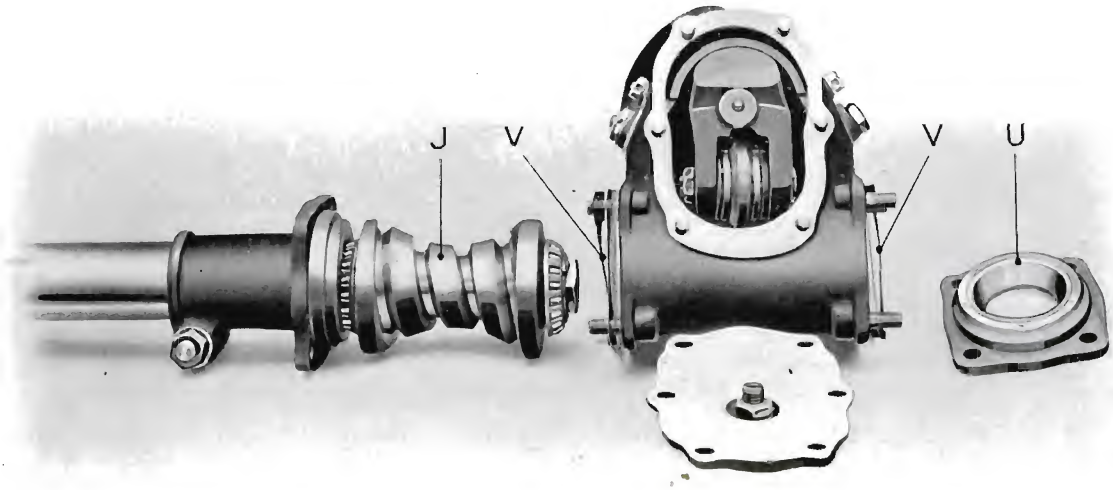


Fig. 5.
Removal of Cam and Bearings.

There should now be no backlash in the mid-position and slight backlash at both extremes. It should be possible to turn the roller with the fingers when it is in any position relative to the cam.

Adjustment No. 4.

The steering ratio is 3.25 to 1, that is, the steering wheel makes that number of revolutions to move the rocker-shaft from one stop in the steering box to the other.

The steering-box stops (*T*), Fig. 1, are correctly set on assembly so that the roller cannot travel within a quarter of a turn from the ends of the cam-track. **These stops should on no account be disturbed.** It is essential that the stops should be set in this position if inadvertently disturbed during overhaul or the stability of the steering may be endangered.

The stops in the steering-box are only intended for use when assembling. When the steering gear is mounted in the chassis **the axle lock-stops must operate before the steering-box stops.** This is important as the steering-box stops may be subjected to excessive loads if the lock is not checked by the axle-stops and serious damage may result.

If, when replaced in the chassis, the turning circles are not equal this can be rectified by lengthening or shortening the drag-link ; this is screwed right and left hand for ease of adjustment.

Replacement of Steering Gear.

When replacing the steering arm on the serrated taper end of the rocker-shaft care must be taken to ensure that the assembly marks correspond. It will be found advantageous to heat the drop-arm to the temperature of boiling water before fitting, to ensure a perfect fit on the taper serrations. The nut must be hammered tight to ensure that the steering-arm is hard on the taper and then split-pinned. The nut must be filed if necessary to bring the pin holes in line. On no account must it be slacked back for this purpose. After replacing the unit on the trunnion-bracket, remove the plug, and replenish the steering box with about one pint of good gear oil.

SECTION 17E

INDEX

GENERAL DESCRIPTION

The braking system on this vehicle embodies wedge-operated self-centring shoes, hydraulically applied in the case of the footbrake. In the case of the handbrake, which operates on rear wheels only, application is by mechanical means, full compensation between the wheels being obtained by a swinging mounting secured on the rear axle. This system, by increasing the leverage at the shoe toes, permits of lightly-loaded rods or cables with no losses due to distortion of cross shafts, none of which are employed. Friction is reduced to a minimum in the linkage and also at the shoe toes where the wedges operate through steel rollers. Adjustment is simple and is effected by means of a stud on each back plate.

Handbrake.

The handbrake is operated by a cable (5), Fig. 1, pulling the lever (12), which picks up by means of dogs on the lever bosses, the double-ended lever (11) and operates the wedges through the pull rods (6 and 9). The link (8) is freely pivoted and so provides full compensation between the wheels.

The brake shoes, shown in Fig. 3, are mounted on an adjuster at the heel and an expander at the toe. The expander is slidably mounted on the back plate so that the shoes are self-centring.

The hardened steel cone (2), which is actuated by the pull rod (6), causes the plungers (4) to move outwards and expand the shoes. Hardened steel rollers (3) are interposed between the cone and the plungers to reduce friction. The brake shoe webs lodge in slots in the ends of the plungers. The rollers are freely mounted and roll up

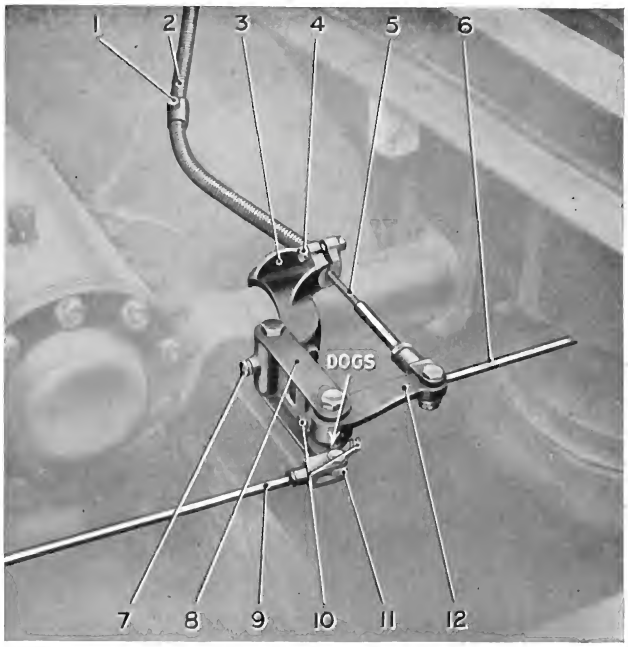


Fig. 1.

COMPENSATOR FOR REAR BRAKES.

1. Nipple for Operating Cable.
2. Outer Cable.
3. Compensator Bracket.
4. Clamp Bolt for Outer Cable.
5. Operating Cable.
6. Operating Rod (short).
7. Nipple for Compensator Link.
8. Compensator Link.
9. Operating Rod (long).
10. Nipple for Operating Lever.
11. Double-Ended Lever.
12. Operating Lever.

BRAKES

the grooves in the plungers and down the inclined face of the cone. This free mounting gives the cone twice the travel of the rollers, thus doubling the overall leverage due to the cone angle. The result of this arrangement is the multiplication of the input effort in the ratio of 7.6 to 1.

The whole expander mechanism is enclosed in an aluminium casing (5), which is secured to the back plate by two studs.

Footbrake.

The footbrake operates on all wheels, the cones in this case being hydraulically actuated. The hydraulic master cylinder (3), Fig. 2, is bolted to the engine rear cross member, the piston being operated by a short push rod connected to the pedal. Fluid from the master cylinder is forced along the pipes (4) to the wheel cylinders (7), Fig. 2, the pistons (16) of which, on rear wheels, pick up the brake rods and operate the cones. The lever (11), Fig. 1, is allowed to swing by the dog arrangement. On front wheels hydraulic operation only is used, and in this case the pistons are coupled direct to the cones. The hydraulic operation ensures equal application on all wheels.

HYDRAULIC SYSTEM

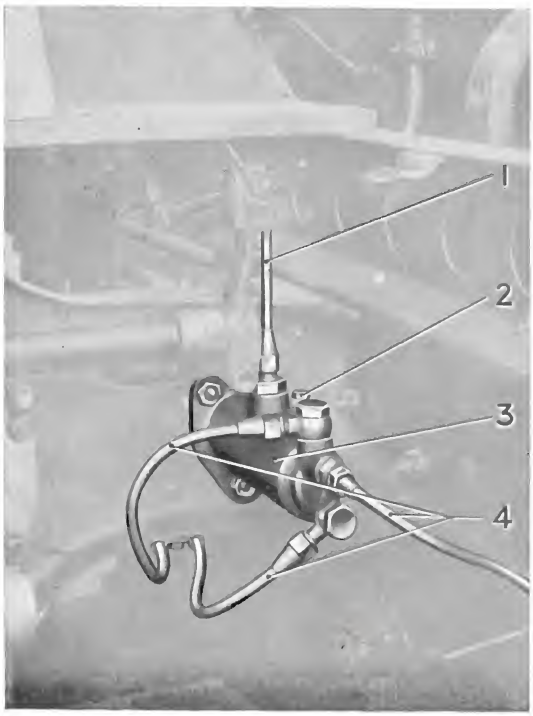


Fig. 2.
MASTER CYLINDER.
1. Feed Pipe.
2. Bleeder Screw.
3. Master Cylinder.
4. Pressure Pipe.

The master cylinder is mounted on a cross member as shown in Fig. 2. The reserve tank containing the fluid is mounted on the bulkhead in the driver's cab and connected to the master cylinder by the feed pipe (12), Fig. 4.

When at rest, the piston (10), Fig. 4, is in the position shown, with the small port just ahead of the cup (9). If the fluid expands, due to a rise in temperature, it passes through this port to the reserve tank, so that a constant volume of fluid is maintained in the system. The piston is retained in the off position by the spring (6), which also holds the inlet valve (3) closed, thus maintaining a pressure of 8 lb. per sq. in. in the system to expand the cups and effectively seal the system. The space behind the piston is kept full of fluid through a diagonal port, leakage being prevented by the auxiliary cup (13). It is essential that the forward port is cleared by the cup when in the off position and to ensure this, the push rod (16) is set with a slight clearance. This clearance will show as about $\frac{3}{4}$ in. free travel on the brake pedal.

Operation of Master Cylinder.

When the pedal is depressed the master piston (10) is pushed forward and forces fluid past the outlet valve (2) through the pressure pipes to the wheel cylinders. When the pedal

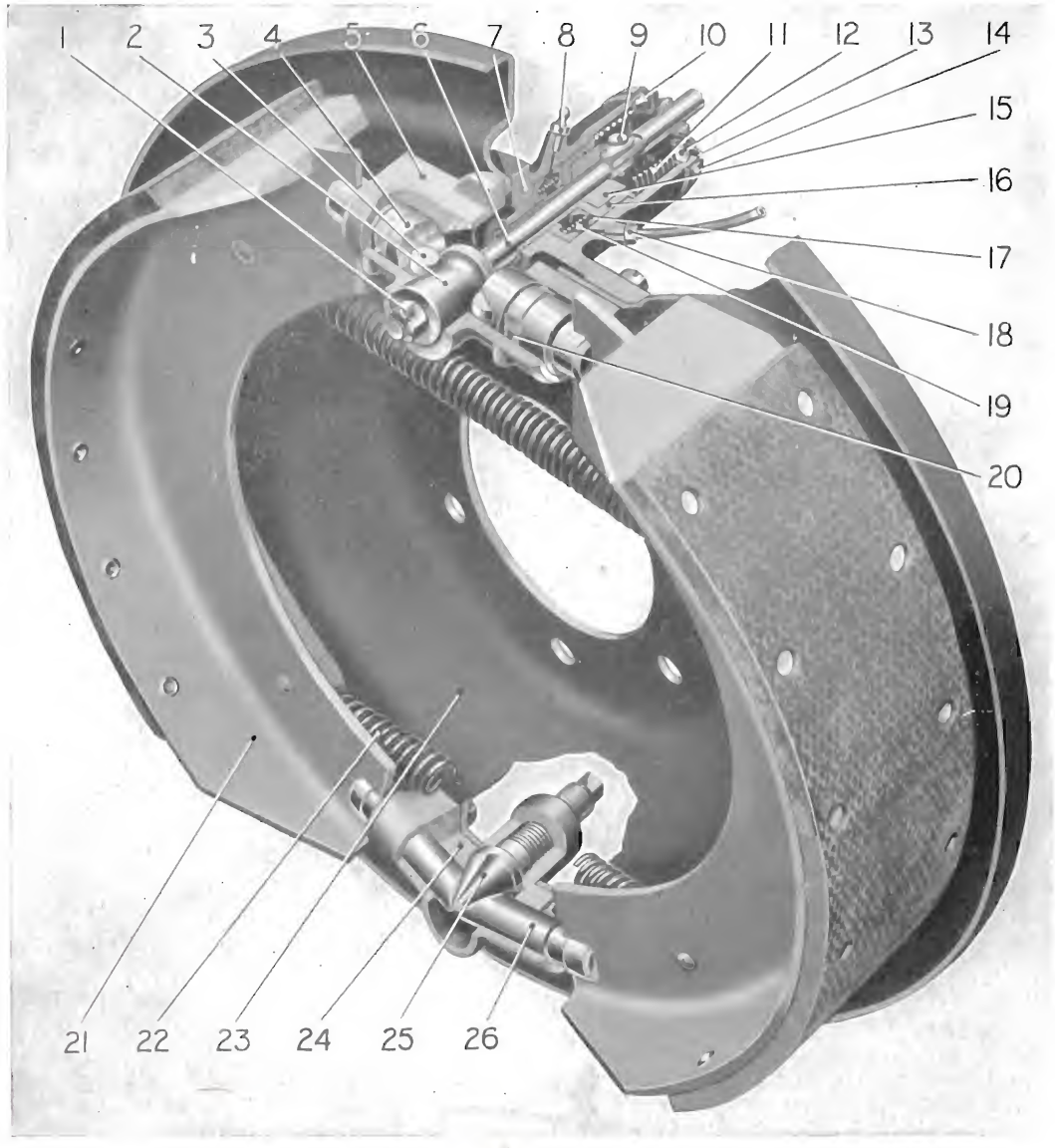


Fig 3.
BRAKE SHOES, SHOWING EXPANDER AND ADJUSTER PART-SECTIONED.

1. Nut for Operating Rod.
2. Expander Cone.
3. Roller for Plunger.
4. Expander Plunger.
5. Expander Casing.
6. Operating Rod.
7. Hydraulic Cylinder
8. Bleeder Screw.
9. Coupling Pin.
10. Circlip.
11. Return Spring.
12. Retaining Washer.
13. Rubber Boot.
14. Clip for Boot.
15. Thrust Block.
16. Piston.
17. Rubber Cup.
18. Pressure Pipe Union.
19. Spring for Cups.
20. Locating Pin for Plunger.
21. Brake Shoe.
22. Pull-off Spring.
23. Back Plate.
24. Adjuster Housing.
25. Adjuster Cone.
26. Adjuster Plunger.

BRAKES

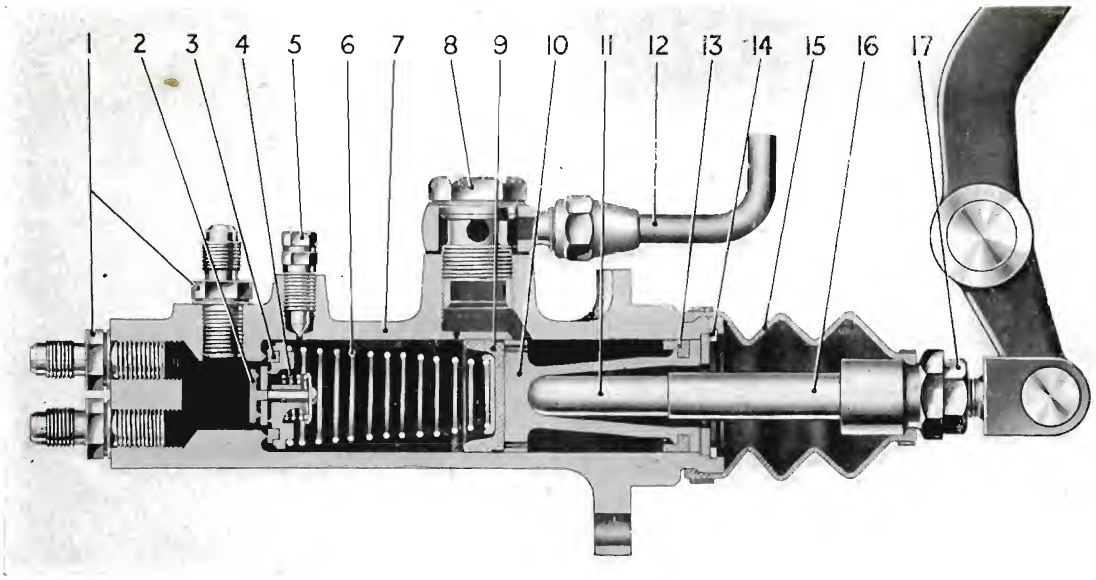


Fig. 4.

SECTION THROUGH MASTER CYLINDER.

1. Pressure Pipe Union.
2. Outlet Valve.
3. Inlet Valve.
4. Outlet Valve Spring.
5. Bleeder Screw.
6. Return Spring.
7. Master Cylinder.
8. Feed Pipe Union.
9. Rubber Cup.
10. Piston.
11. Push Rod.
12. Feed Pipe.
13. Sealing Cup.
14. Circlip.
15. Rubber Boot.
16. Push Rod.
17. Locking Nut.

is released the piston is forced back to the off position by the return spring (6), and the fluid from the wheel cylinders returns to the master cylinder. The inlet valve (3) closes when the pressure in the system is balanced by the return spring.

The fluid may return at a slower rate than the master piston, and a momentary vacuum is established, high enough to cause fluid from behind the piston to pass through the ports in the piston head and pass the edges of the cup (9). The excess fluid thus introduced returns to the reserve tank through the forward port.

Fluid.

The fluid used in the system is known as Genuine Lockheed Brake Fluid and no other fluid must be used or trouble will be experienced with the rubber cups swelling. The fluid is immune from freezing and is unaffected by high temperature.

ADJUSTMENT

Only one adjustment is provided and that is direct on the brake shoes. A square-headed stud, shown in Fig. 5, is provided on each back plate to adjust the shoes. Turn this stud with a spanner in a clockwise direction until resistance is felt, then slack

back one notch, which can be both felt and heard. **All adjusters operate in a clockwise direction.** It is not necessary to jack up the wheels.

The adjuster is shown in Fig. 3. A hardened steel cone (25) is formed on a fine threaded spindle and mounted in a steel housing (24) bolted to the back plate. The outer end of the spindle is square for spanner operation and four flats are formed on the face of the cone. The cone is located between the inclined faces of the two plungers (26) on which the shoes are mounted. Rotating the cone clockwise moves it inwards, forcing apart the plungers and expanding the shoes.

LUBRICATION

1. **Handbrake Lever.** Weekly, through the nipples in the lever boss.
2. **Footbrake Pedal.** Weekly, through the nipples in the pedal boss.
3. **Compensator Lever.** Weekly through the nipples (7 and 10) shown in Fig. 1.
4. **Operating Cable.** Weekly through the nipple (1), Fig. 1.

MAINTENANCE

Regular attention to the following points will ensure that the braking system is kept in a highly efficient condition and minimise the possibility of defects developing :—

1. Keep all pressure connections tight.
2. Check fluid level in reserve tank (in driver's cab) twice weekly and replenish to within ½ in. of the top with Genuine Lockheed Brake Fluid.
3. If there are indications of oil reaching the brake drums, wash the shoes in petrol and fit new oil seals (see "Front Axle" and "Rear Axle").
4. Check that all road spring clips are dead tight, particularly on front axle (see "Road Springs").
5. Check that there is ¾ in. free travel on the brake pedal.

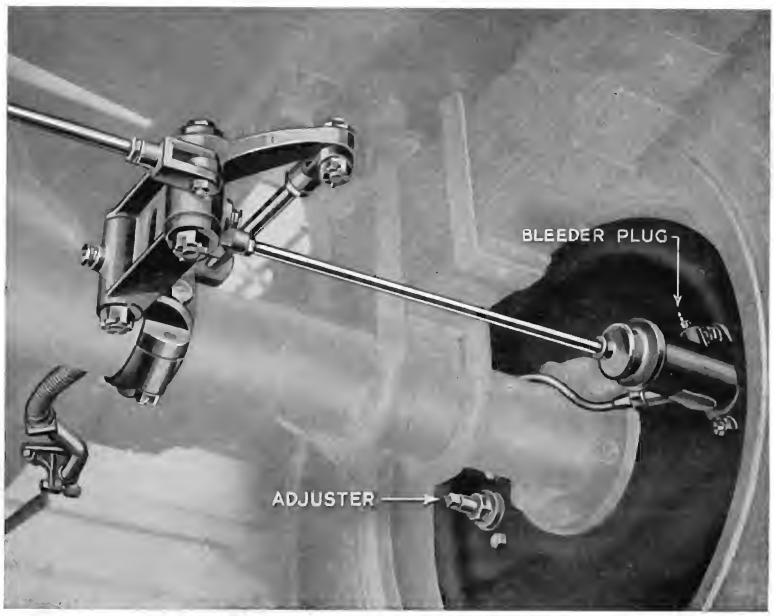
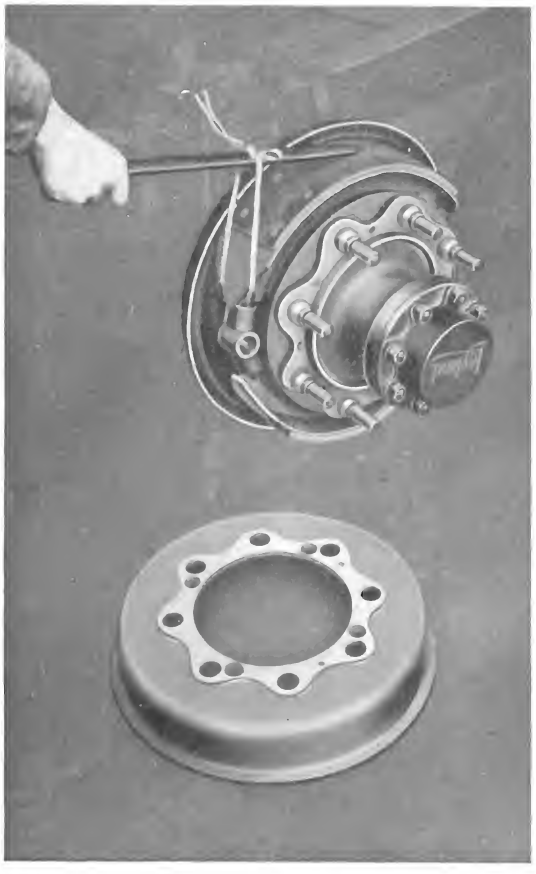


Fig. 5.
BACK PLATE SHOWING ADJUSTER AND BLEEDER

BRAKES



REMOVAL OF BRAKE SHOES.

Bleeding the System.

Whenever any part of the hydraulic system has been disconnected or if the fluid level in the tank has been allowed to get too low, air will be introduced into the system and bleeding is necessary to expel all air.

Fill up the reserve tank before starting the operation and keep the tank at least half full during the whole operation of bleeding. **It is important that the master cylinder be bled before bleeding the wheel cylinders.** A bleeder plug (2), Fig 2, is provided on the end of the master cylinder.

Remove the plug and screw in the bleeder-drain. Allow the rubber tube to hang in a clean glass container, slack off the bleeder screw one half-turn and pump the brake pedal at least ten times. Keep the end of the tube below the level of the fluid while pumping and note when air bubbles cease to appear. Then, while slowly depressing the pedal, tighten the bleeder screw. Remove the drain and replace the plug.

Repeat the operation on each wheel cylinder, replenishing the reserve tank each time. If the tank is emptied while bleeding, air will be drawn in and necessitate re-bleeding.

Fluid withdrawn during bleeding must not be used again unless it is clean and free from dilution. In this case strain through fine, non-fluffy material and replace in the tank. **Unless these precautions are taken, it must not be used.**

Hydraulic Faults.

If the pedal goes right down to the floor-boards or two strokes are required to apply the brakes, check the following :

1. If the pedal has a springy or spongy feeling it is probably caused by air in the system which must be bled to expel air.
2. Leak in the pipe line or empty tank. The pedal will go right down and will not create pressure. Fill up the tank, examine all pipes and joints. Rectify the fault and bleed the system.
3. If under sustained pressure the pedal moves slowly down, there is a slight leak in the system. To trace this pressure must be kept on the pedal while the joints are inspected. Fill up the tank when the trouble is rectified.

Sluggish Operation.

Should the brakes appear sluggish in coming on or off, this is probably due to unsuitable fluid or presence of oil causing the rubber cups to swell. In this case the expanders must be dismantled and new cups fitted.

Oil on the liners will cause loss of efficiency ; if on one wheel, unequal braking will result. Oil may also cause the shoes to stick when brake is released.

OVERHAUL

Reline the shoes when the liners have worn down to 3/32 in. Always reline all shoes at the same time and with the same material, or uneven braking may result. Use liners supplied by Leyland Service Depot. Countersink the rivets to about three-quarters the depth of the liner and rub over with a rough file to remove the burrs. If the drums are scored skim up to a smooth surface or renew.

Removal of Brake Shoes.

Jack up the axle and remove the wheels and brake drums. The drums are located by small countersunk screws and tapped holes are provided for screwing in long $\frac{3}{8}$-in. B.S.F. bolts to draw off the drums. With a long screwdriver or a length of cord and lever, lift the shoes out of the slots in the plungers and ease outwards as shown in Figs. 6 and 7. The pull-off springs are between the shoes and the back plate and can now be unhooked and the shoes removed. Do not overstretch the pull-off springs. The expanders and adjusters should not be removed from the back plate, but cleaned down and checked for freedom of movement.

Replacing Shoes.

Hook the pull-off springs on the top shoe and replace the shoe clear of the plungers, as shown in Fig. 8, hold the bottom shoe in position and hook on the pull-off springs. Ease the shoes with the screwdriver as for removal into the slots in the plungers. **The springs must be replaced between the shoes and the back plate.**

Adjustment after Relining.

Slack off the two set-screws (seen in Fig. 5), securing the adjuster housing to the back plate. Screw in the adjuster until the shoes are hard against the drums. Tighten the two set-screws, slack off the adjuster one notch, give the brake pedal a firm application to ensure shoes centralising on the drum. Do not tighten up dead the two brass nuts securing the expander to the back plate. **These should be one turn slack and have double coil spring washers fitted to allow the expander to float.**

Removal of Master Cylinder.

The master cylinder should require very little attention, but at overhaul it may be desired to remove it for inspection.

Disconnect all the pressure pipes (4), Fig. 2, and the feed pipe (1). Remove the clip securing the rubber boot to the push rod, take out the bolts securing the cylinder to the cross member and draw the cylinder clear.

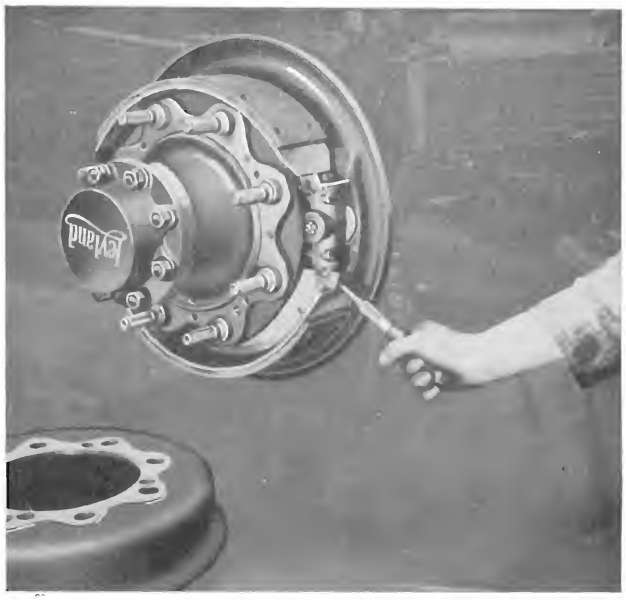


Fig. 7.
REMOVAL OF BRAKE SHOES.

BRAKES

Fig. 8.
REPLACING BRAKE SHOES.

Dismantling Master Cylinder.

Remove the boot (15), Fig. 4, from the rear end, extract the circlip (14) and remove the retaining washer. The piston, cup, spring and valves can then be drawn out of the bore.

Cleaning Master Cylinder.

Clean all parts in Lockheed Fluid or methylated spirit. **Petrol, paraffin or oil must not be used.** Renew the rubber cup (9) if perished. The cylinder bore can be cleaned with crocus powder and a soft cloth and then washed out with methylated spirit.

Replacing Master Cylinder.

Replace the master cylinder on the cross member, feeding the push-rod into the piston and tighten the bolts. Check that the pedal has $\frac{3}{4}$ in. free travel; adjust if necessary by slackening off the locknut (17), Fig. 4, and turning the adjusting nut until the correct travel is obtained, then tighten the locknut. Clip up the rubber boot.

Fill up the supply tank, bleed the master cylinder and wheel cylinders (see " Bleeding the System ").

ROAD SPRINGS

SECTION 18C

INDEX

ROAD SPRINGS

GENERAL DESCRIPTION

The road springs are designed to give easy riding combined with adequate strength to withstand the severest operating conditions. The front springs on passenger machines are shackled at the front end and on goods vehicles at the rear end. Passenger type rear springs are underslung being secured to the axle by alloy steel U bolts. The rear springs on goods six wheelers are of the inverted type pivoted on pins mounted in robust brackets secured to the frame side members. These springs have trunnion ends in order to provide adequate articulation, but plain rolled-eye springs can be fitted for main road operation. Rubber bumpers are fitted to all springs to prevent damage through violent road shocks.

All the springs are of silico-manganese steel 2½ ins. wide and large diameter shackle pins are used, similar pins being fitted throughout the vehicle.

LUBRICATION

Grease must not be used for lubrication purposes, gear oil should be used in all cases.

Shackle Pins.

A supply of gear oil should be given daily through the lubrication nipples.

The anchored ends are in most cases piped up to the lubrication batteries. At the shackled end a separate nipple is screwed into the moving pin, the fixed pin being piped up to the batteries, but in some cases a separate nipple is fitted. On six wheelers the nipples for the rear spring-shackle pins are in the small batteries on the rear axles.

The exact positions for this machine are shown in the lubrication chart.

Pivot Bushes (Six Wheelers).

A supply of gear oil should be given daily through the nipples in the rear lubrication batteries.

Spring Leaves.

When docking, the vehicle should be jacked up under the frame, the springs cleaned and painted with heavy oil which will work into the springs in service.

MAINTENANCE

An adjustment is provided for taking up end play on the shackle pins. This adjustment should be carried out when docking. To adjust the pins, slack off the clamp bolt nearest to the slotted nut, remove the split pin and tighten the nut. Slack back one half turn to give running clearance, replace the split pin and tighten the clamp bolt.

Spring Bolts.

The springs are secured to the axles by alloy steel U bolts. **It is essential that the spring U bolts are kept dead tight : Inspect for tightness after the first 500 miles and then at every dock.** The nuts are prevented from slacking back by shakeproof washers, the split pins in the bolt ends are to prevent losing the nuts in the event of their being slacked off.

The nuts may become slack due to slight stretch in the spring U bolts or bedding down of the spring leaves. Loose spring bolts will cause spring breakage and undue wear ; brake judder can also arise from the same cause.

Inspect the springs periodically and replace any broken leaves.

ROAD SPRINGS

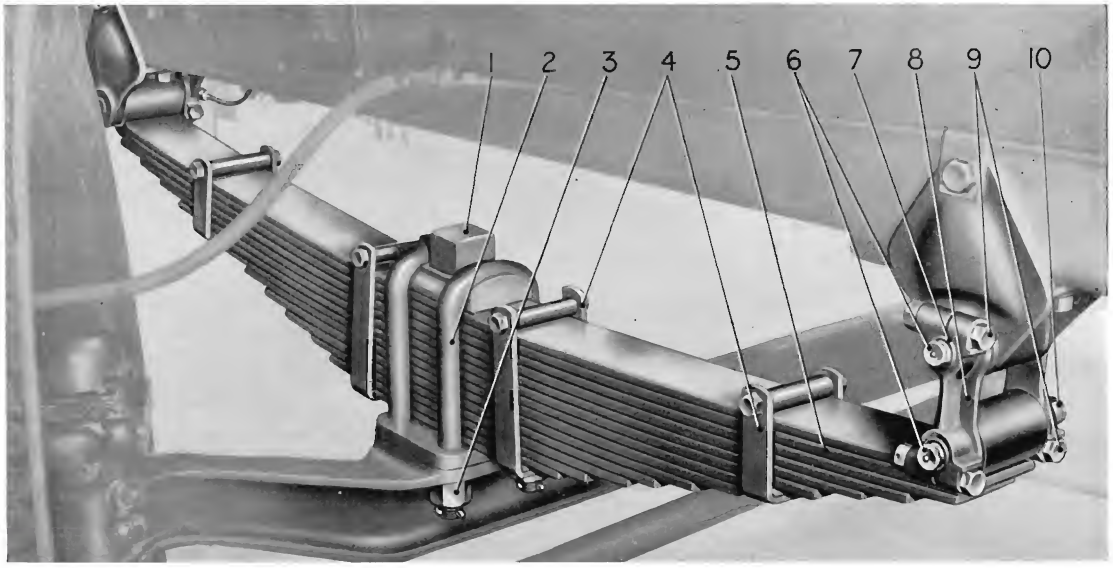


Fig. 1.
FRONT SPRING.

1. Rubber Bumper
2. U Bolt.
3. Nut for U Bolt.
4. Spring Leaf Clip
5. Front Spring.
6. Lubrication Nipple
7. Shackle Pin.
8. Spring Shackle.
9. Clamp Bolt.
10. Adjusting Nut

OVERHAUL

At overhaul it is advisable to remove the springs with the axles and to reassemble the springs on the axles before replacing. The axles can be removed complete with springs by packing up under the frame, removing the wheels, taking out the clamp bolts and withdrawing the shackle pins. Brake pressure-pipes or rods and propeller shafts must first be disconnected.

Removal of Front Spring.

To replace a broken spring, pack up firmly under the frame, jack up the axle and remove the wheel. Remove the U bolts securing the spring to the axle, take out the clamp bolts and withdraw the shackle pins ; the spring can then be removed.

Removal of Rear Spring (Four Wheelers).

To replace a broken spring, pack up under the frame, jack up the axle and remove the wheel. Take out the U bolts securing the spring to the axle, remove the clamp bolts and withdraw the shackle pins.

Rear Springs (Six Wheelers).

The rear springs on six-wheelers are supported on pivot pins (14), Fig. 2, taper fitted in triangular brackets secured to the frame side members and strengthened by a cross tube. The springs are secured to the spring-seat brackets (4) by alloy steel bolts. The spring-seat brackets have flanged bushes (13) pressed in from each end and are located on the pivot pin between two thrust washers (5) and (11), one dowelled to the triangular bracket, the other to the pivot pin. The assembly is secured by a large nut (7) which is split pinned, shims (8) being fitted so that the nut can be pulled dead tight without nipping the spring-seat bracket. Dirt and water are excluded by two felt washers (10). Lubrication is effected through nipples in the lubrication batteries.

ROAD SPRINGS

The springs are of the inverted type with trunnion ends, the shackle pins passing through steel bushes in rollers which can turn laterally to permit of full articulation without stressing the springs. In some cases plain rolled-eye springs are fitted.

Removal of Rear Springs (Six Wheelers).

If at overhaul the axles are to be dismantled, the simplest method of removing the springs is first to remove the bogie unit. Pack up under the frame and remove the mudguards ; disconnect the brake pressure pipes and propeller shaft. Take off the nuts securing the triangular brackets to the frame and the bogie unit can be wheeled out to the rear of the chassis.

To replace a broken spring, pack up under the frame high enough to take all weight off the spring ; jack up under the axles and remove the wheels. Remove the bolts securing the spring to the spring-seat bracket (4), Fig. 2, take out the clamp bolts and withdraw the shackle pins. The shackle pins have $\frac{3}{8}$ in. B.S.F. tapped holes, so that bolts can be screwed in to facilitate their withdrawal. Jack up the axles high enough to allows the spring to clear the axle brackets and the spring can be removed.

To withdraw the spring-seat bracket take out the split pin and remove the retaining nut (7).

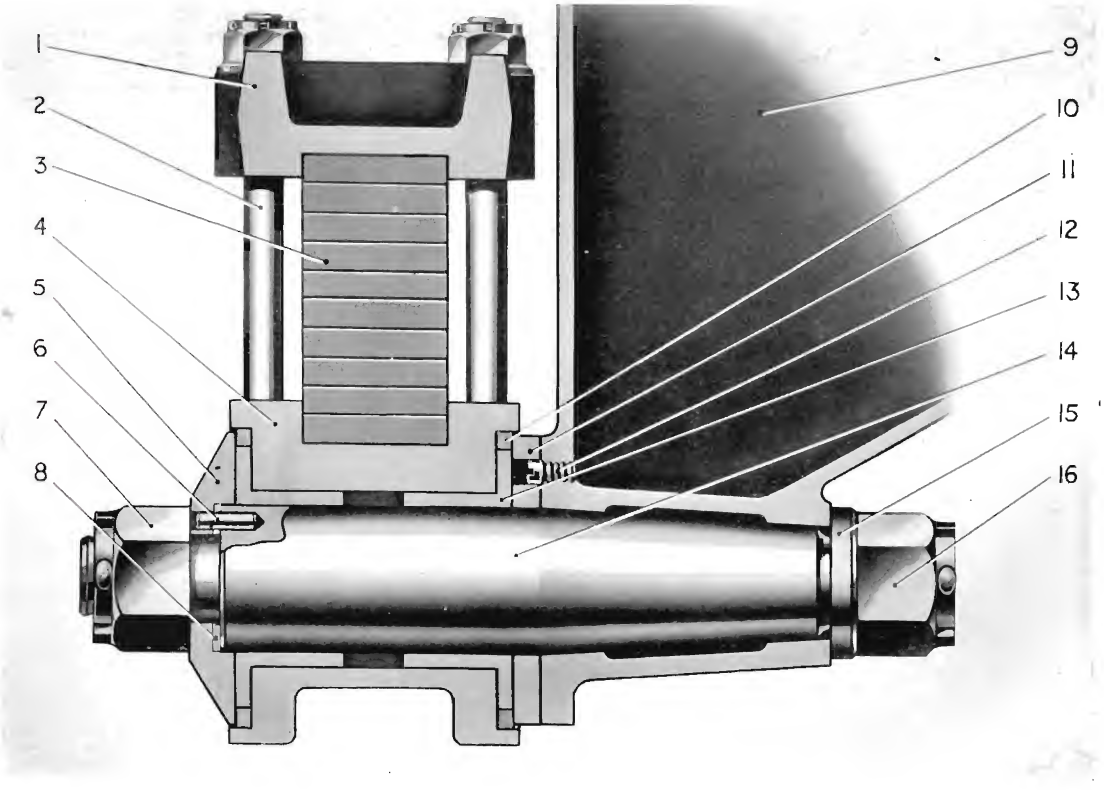


Fig. 2.
REAR SPRING MOUNTING (six wheelers).

1. Clamping Plate.
2. Spring Bolts.
3. Rear Spring.
4. Spring-seat Bracket.
5. Thrust Washer (outer).
6. Dowel Peg.
7. Retaining Nut.
8. Shims.
9. Spring Bracket.
10. Felt Washer.
11. Thrust Washer (inner)
12. Dowel Screw
13. Bush.
14. Pivot Pin
15. Pivot Pin Washer.
16. Pivot Pin Lock Nut.

ROAD SPRINGS

Replacing Rear Springs (Six Wheelers).

The spring-seat bracket bushes should be renewed if there is excessive play on the pivot pin. When replacing the spring-seat bracket, check that the thrust washers are located on the dowels and that the felt washers are replaced. Tighten the retaining nut dead tight, fitting or removing shims (8), Fig. 2, until the spring-seat bracket can pivot freely without end play, then split pin the nut. Do not nip the spring-seat bracket.

Lift the spring into position on the spring-seat bracket, replace the spring bolts and tighten the nuts. **The nuts must be pulled up dead tight with a 4 ft. bar. The spring leaf clips have round headed bolts and these should be fitted with the heads inside so that the nuts do not foul the axle slings. Lower the axles, insert the shackle pins and tighten the clamp bolts. The shackle pins should be replaced with the tapped holes outside so that they are accessible for withdrawing the pins on a future occasion.**

Re-assembling Springs (All Types).

When reassembling springs after replacing a broken leaf, see that each leaf beds down at the tips and that the leaf clips are replaced. Replacement leaves should be obtained from a Leyland Service Depot.

At overhaul, springs should be dismantled and retempered. It is strongly recommended that broken springs and springs for retempering should be sent to a Leyland Service Depot to ensure correct treatment and rebuilding.

Before rebuilding springs make sure that the eyes are dead in line, the shackle pins must not be forced in. The springs should be assembled on the axles and the eyes checked for alignment, if they are out of line the shackle pins cannot be replaced. In this case the spring should be retempered and correctly set. The rear spring bolts must be pulled up dead tight using a 4 ft. bar. Tighten all nuts evenly, replace all shackle pins and tighten all clamp bolts.

SECTION 22A

INDEX

GENERAL DESCRIPTION

The electrical equipment on all machines has been carefully selected in order to give satisfactory illumination with reliability, ease of control and little maintenance. The C. A. V. Bosch compensated voltage system is standardised throughout the range, with Simms equipment as an alternative when specified by customers.

On petrol-engined machines a 12-volt system is used throughout, but on oil-engined machines a 24-volt starter motor is fitted. The remainder of the system is 12 volts. Two 12-volt batteries are arranged in parallel for charging and lighting, a series-parallel switch placing the batteries in series for operating the starter motor. Full details of the standard equipment are given on the wiring diagram.

LUBRICATION

Dynamo.

In all cases the dynamo bearings are lubricated by means of grease cups (*A*), Fig. 1. Give the greasers a turn once a week and replenish with high-melting-point grease when empty. **Do not use oil.**

Starter Motor.

Lubricate periodically with a few drops of engine oil through the oil cup (*R*), Fig. 9. The starter motor fitted on four-cylinder petrol engines is graphite lubricated and does not require attention till overhaul.

MAINTENANCE

Dynamo Brushes and Commutator.

Inspect the brushes frequently for wear and freedom in holders, commutator should be free from grease or carbon dust.

Battery.

Inspect the electrolyte level weekly and top up with distilled water if low. **Do not use tap water.**

Starter Motor.

Inspect brushes and commutator when docking.

Wiring.

Check, when docking, that all connections are tight and clean, particularly those on battery, dynamo, and starter motor. Clean battery terminals if corroded and smear with vaseline.

Fuses.

If a fuse blows, replace with one of the same capacity (see wiring diagram). If it blows again, trace the fault, possibly loose connection or wiring fault.

ELECTRICAL EQUIPMENT

DYNAMO

The dynamo is mounted on a cradle at the near side of the engine and secured by a strap; it can readily be removed by disconnecting the flexible couplings (*B*), Fig. 1, and removing the bolt (*C*) from the strap. On certain oil-engine machines the fuel pump must first be removed. The dynamo is a plain shunt-wound machine having two brushes only, the regulator controlling the current according to battery requirements.

The chief feature of the compensated-voltage system is that the condition of the battery determines the output of the dynamo. When in a fully charged condition the battery receives only a trickle charge, which increases as the battery condition becomes lower until, when fully discharged it receives the full charge that the dynamo is designed to produce, provided that the dynamo is running at a reasonable speed. If an ammeter is introduced into the circuit it will only show one or two amps. charge when the battery is in a fully charged condition.

Care of Dynamo.

A serious overhaul of the dynamo is a specialised job and should only be undertaken by an expert, but satisfactory operation will be ensured if attention is given to the following points :—

1. Keep all connections tight.
2. Keep the commutator free from grease.

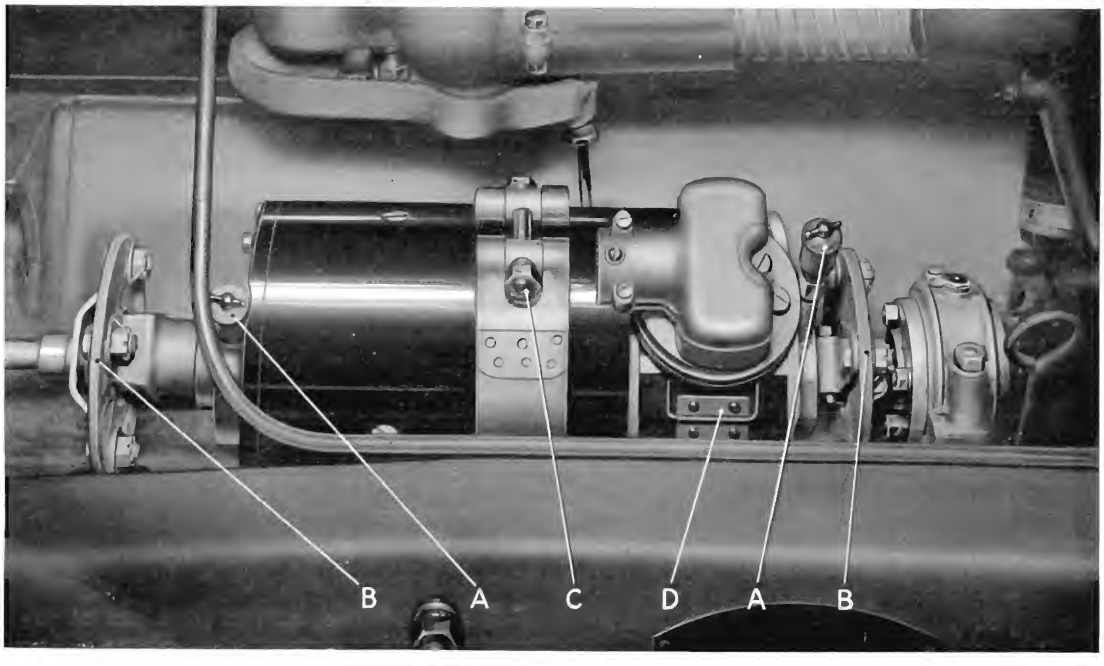


Fig. 1.
Dynamo.

clean if necessary with a rag dipped in petrol. **Do not use emery cloth.**

3. Examine the bushes periodically and renew if worn down to less than half their length. Use only the grade of brushes supplied by the manufacturer.
4. When fitting new brushes make certain that they are bedding properly.
5. Observe that the brushes move freely in their holders and that a spring pressure of 16—18 ozs. is maintained on the brush triggers.
6. Lubricate the ball races at each end of the dynamo by means of the greasers provided. These should be filled with good quality grease havin a high melting point and entirely free from an acid foundation. **Do not use oil.**

The commutator and brushes can be inspected by removing the cover (*D*), Fig. 1.

Fig. 2.
Hydrometer.

REGULATOR

The regulator is incorporated in the dynamo on all goods vehicles fitted with petrol engines, four-cylinder oil engines or light 6-cylinder engines. On goods vehicles fitted with six-cylinder oil engines and on all passenger machines the regulator is mounted on the control board on the bulkhead.

The regulator controls the dynamo voltage under all conditions of speed and output. It consists primarily of an electro-magnet with two windings and a floating, spring-controlled plunger. The plunger has at one end a contact tip which, when at rear, bears lightly against a fixed contact. In this position a fixed resistance in the field circuit is short-circuited and the field windings are subjected to the full voltage generated by the dynamo. When in operation the plunger vibrates rapidly, opening and closing the contact. On the contacts breaking the fixed resistance is brought into circuit with the field windings, causing a fall in the pressure to which they are subjected and reducing the field current so that the dynamo voltage falls. As the plunger again makes contact the reverse action takes place and the voltage rises. The dynamo voltage is, therefore, held steady at an average value between the two extremes or approximately 14 volts.

Frequency of vibration is controlled by dynamo speed and output, the output being decided by the state of the battery and the lamp load, or by the battery alone when the lights are not in use.

Regulator Adjustment.

The regulator is carefully set by the manufacturer to suit the type of dynamo with which it is to operate. It is then

ELECTRICAL EQUIPMENT

sealed and should never be interfered with except under the supervision of the manufacturers. A brief outline of the method of adjustment is given, however, to assist operators in remote districts or in emergencies.

To set the regulator, first disconnect the battery, switch off all lights and connect a voltmeter of suitable range in place of the battery. Turn the knurled brass knob at the left-hand side of the regulator until the required voltage is registered.

The voltage for which the regulator should be set for various types of battery at a dynamo speed of about 1,000 r.p.m. is shown in the following table :

	Battery Type	*Dynamo Voltage*
Lead Acid ..	6 Cells	15 to 15.5
Edison	8 ,,	14.5 ,, 15.0
Edison	9 ,,	16.0 ,, 16.5
Edison	10 ,,	17.5 ,, 18.0
Alklum	8 ,,	14.0 ,, 14.5
Alklum	9 ,,	15.5 ,, 16.0
Nife	9 ,,	15.5 ,, 16.0
Nife	10 ,,	17.0 ,, 17.5
Ionic	9 ,,	15.5 ,, 16.0

BATTERIES

Lead-Acid Batteries.

The specific gravity of the acid in this type of battery should not be allowed to fall below 1.180 at 60° F., as to allow the battery to become fully discharged will considerably shorten its life. When fully charged the sp. gr. should be from 1.280 to 1.300 at 60° F.

If, during charging, the specific gravity of any cell or cells fails to rise, the acid should be drained out and the defective cells examined for internal short circuits. The short circuits should be rectified and the cells filled with acid of not more than 1.200 sp. gr. After refilling, charge the battery from an independent source, in accordance with the instructions on the label attached to the case, until the acid rises to between 1.280 and 1.300 sp. gr.

The acid in each cell must cover the plates to a depth of $\frac{3}{8}$ in., loss due to evaporation must be made good by the addition of chemically pure distilled water before beginning a charge. If any acid is spilled it must be made good by adding acid of the same specific gravity as that in the cell.

The acid level should be checked weekly and the battery topped-up with distilled water. The voltage per cell should also be checked weekly while the battery is in a fully charged condition. Once a month it is advisable that the battery be given a charge from an independent source.

The battery should be emptied every six months when in a fully-charged condition and flushed out with diluted acid to remove deposit from between the plates. After flushing, the acid should be replaced and the battery put on charge again. During this operation it will be necessary to add a small quantity of fresh acid to compensate for absorption and loss.

At the end of a day's run, with the engine stopped and all lights on, the terminal voltage of a 12-volt battery should read 12.0 to 12.5 volts.

Do not leave the battery in a run-down condition, or it may be permanently damaged. Test the voltage with all lights on and engine stopped ; if it is down to 10 volts, the battery is in a dangerously low state and should be recharged at once.

Notes on Use of Hydrometer.

To test the specific gravity of the acid during various stages of charge a hydrometer will be required. A typical example of this instrument is shown in Fig. 2.

The graduations are clearly marked on the scale, but to facilitate readings some instruments are provided with an additional indicator. This takes the form of a float, which arises and obscures either Black, Red or Green, according to the sp. gr.

When Black is showing, the battery is in a discharged condition, corresponding to 1.180 sp. gr. When Green is showing the battery is half charged, and Red indicates that the battery is fully charged—1.280 to 1.300 sp. gr.

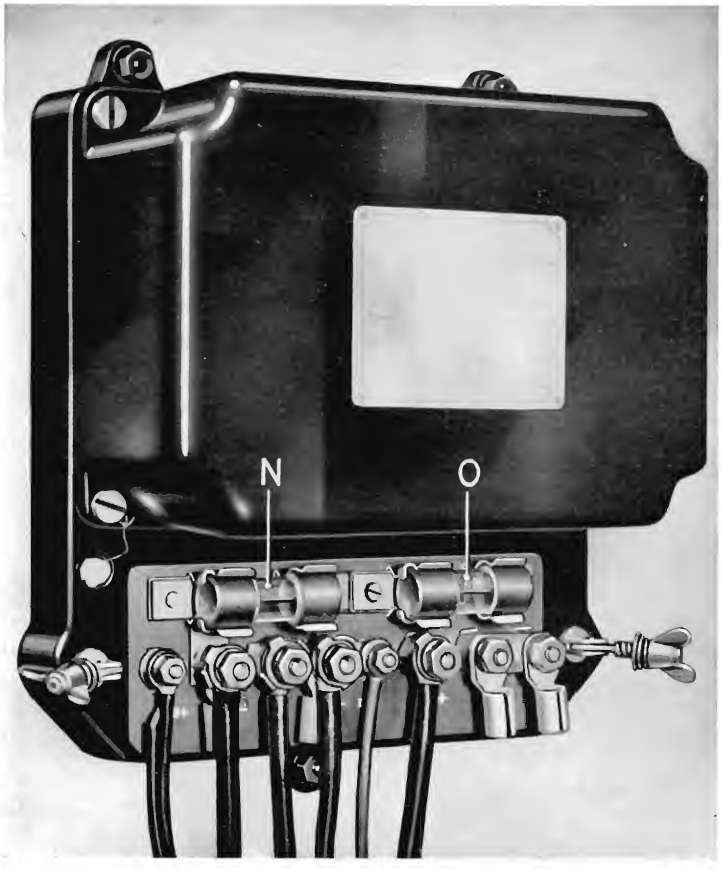


Fig. 3.
Control Board.

Nickel-Iron-Alkaline Batteries.

This type of battery is only fitted when specified by customers and requires a special regulator. The electrolyte is an alkaline solution which should be obtained from the battery manufacturers. The sp. gr. is 1.190 or as recommended by the manufacturers.

On no account must acid be put into this type of battery or it will be ruined.

The specific gravity of an alkaline battery remains constant ; it does not rise and fall during charge or discharge as with the lead-acid type. It does, however, become diluted during these phases and it should be removed at overhaul or when it falls from the normal 1.170 to 1.160 sp. gr.

Batteries for export have the electrolyte supplied in a solid or powder form and this should be dissolved in distilled water in the proportion of 4 lb. solid to 1 gallon of water. The solution should be made in a clean iron, glass, or earthenware receptacle.

The electrolyte is a strong solution and should not be allowed to come into contact with the hands or clothing.

Allow the solution to cool before testing for sp. gr., which should be 1.190.

The normal charging voltage is 1.4 volts per cell at the commencement ; but, in order to keep the current constant, this

ELECTRICAL EQUIPMENT

should be raised gradually to 1.8 volts per cell towards the end of the charge.

The battery is considered fully discharged when each cell indicates 1.1 volts at normal discharge rates.

The dynamo charging rate should be regulated so that with various types of alkaline battery the figure given under "Battery Charging Voltage" applies on an open circuit.

Care of Alkaline Batteries.

The following points should be observed to prevent damage and ensure efficient service from the batteries.

1. Do not lift the cells by the filler caps.
2. Sulphuric acid will ruin alkaline batteries, and utensils which have at any time been in contact with lead-acid battery electrolyte, must not be used.
3. Keep the electrolyte at the correct height above the plates, 1½ in. for high type, ½ in. for low type. Use only distilled water for topping-up.
4. When topping-up, take great care not to spill water over the cells and crates.
5. Keep the cells and crates clean and dry, the cell tops greased with vaseline and all connections screwed up tight.
6. Never examine the cells with an open flame.
7. Never leave filler caps open, and when renewing electrolyte do not allow cells to stand with interiors exposed. Carry out the change as expeditiously as possible, as the atmosphere is injurious to the plates.
8. Do not leave tools or other pieces of metal lying along the top of the cells and take great care that the terminal units, connecting lugs, tools, etc., are not left between the cells. All the cell cases are alive and if contact is made between them, short circuits will be caused and considerable damage may result.

CUT-OUT

The object of the cut-out is to prevent the current flowing from the battery to the dynamo when the latter is not charging at an effective rate or when stationary. Briefly, it consists of an electro-magnet which makes a contact when the dynamo develops an effective output, allowing the current to flow to the battery. When the output falls below this rate the electro-magneto ceases to operate and the contact is broken.

The cut-out is incorporated in the dynamo on goods vehicles fitted with petrol engines, but on all other machines it is fitted on the control board. In both cases, it is set by the manufacturers and sealed. The seal should not be broken except under the supervision of the manufacturers.

WIRING

On passenger machines the wires are run through accessible mouldings and are distinctively coloured to facilitate tracing a defective circuit. The colour used for each circuit and the type of cable used is indicated on the wiring diagram.

On goods vehicles, twin vulcanised, armoured cables are used. These are water and oil proof and are run in accessible positions.

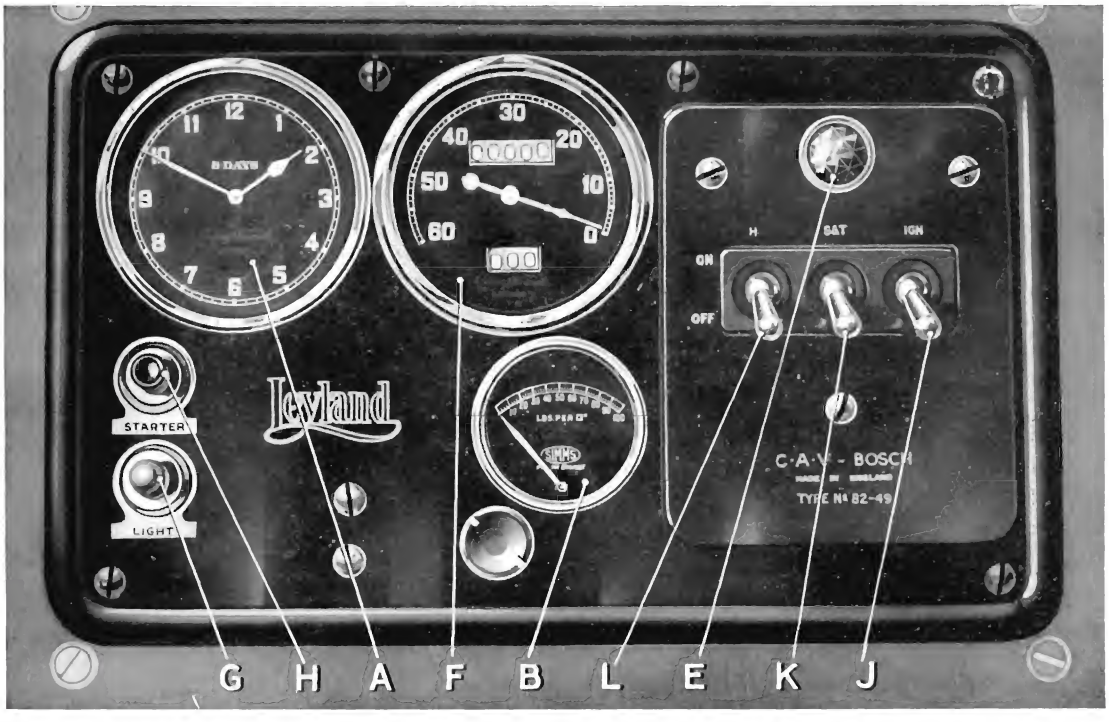


Fig. 4.
Combined Switchboard and Instrument Panel (Petrol Engine).

SWITCHBOARD

On all machines, except the Titan and three-axle passenger, a combined switchboard and instrument panel is fitted. The combined panels are shown in Figs. 4 and 5, and the Titan switchboard in Fig. 6. The following equipment is provided :—

(*A*) *Eight-day Clock.*—The winding gear is brought within easy reach by a flexible shaft.

(*B*) *Oil-Pressure Gauge.*—Operating on Lion, Tiger, and Titan, in conjunction with

(*C*) *Electric Oil-Pressure Indicator.*—Blue light.

(*D*) *Vacuum Gauge.*—On oil-engined machines only.

(*E*) *Dynamo Charging-Indicator.* — Red light.

(*F*) *Speedometer.*- With trip mileage recorder.

(*G*) *Push-Button Switch.* — For panel illuminating lights.

(*H*) *Starter Switch.*—On petrol-engined machines only. On oil-engined machines, a foot-operated series-parallel switch is fitted under the cab floorboards.

(*J*) *Ignition Switch.*—Which also controls the dynamo charging light and oil-

ELECTRICAL EQUIPMENT

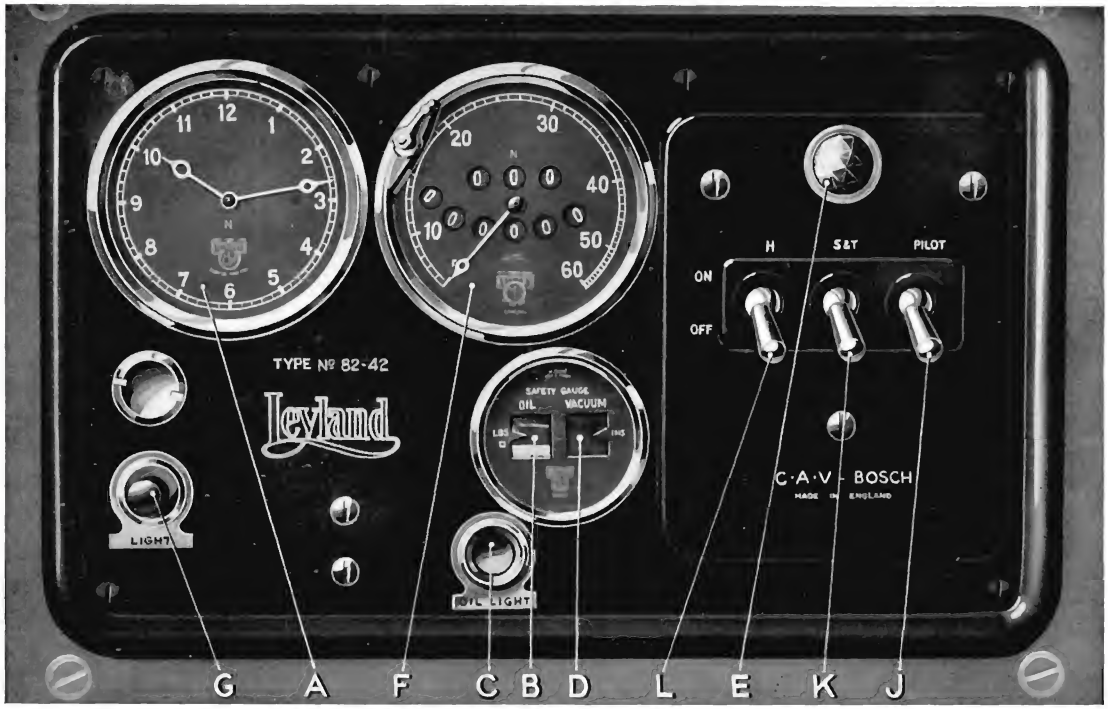


Fig. 5.
Combined Switchboard and Instrument Panel (Oil Engine).

pressure light. On oil-engined machines, controls the indicator lights only and should always be switched on when engine is started.

The ignition switch is suitable for use with either magneto or coil ignition, but not for dual. The terminal (*E*) on the wiring diagram is for earthing when a magneto is fitted and is not required for coil ignition.

(*K*) *Master Lighting Switch.*—On Titan and three-axle Tiger also operates side and tail lights; headlights and interior lights cannot be operated until this switch is on. On all other machines, operates side and tail lights only.

(*L*) *Headlamp Switch.*—Dimmer switch is on the steering column.

(*M*) *Fog Light Switch.*—On separate switchboard only, a special switch is used on other machines.

All instruments are illuminated at night by a concealed bulb controlled by the button. The panel lights cannot be switched on until the ignition switch (*J*) (pilot switch with oil engines) is on.

The ignition or pilot switch must be switched "off" before leaving the machine.

INDICATOR LIGHTS

"Red" Charging Light.

With magneto ignition the lamp (*E*) lights :—

1. When ignition is switched on.
2. When the dynamo is not charging the battery, or if the engine speed

falls below dynamo cutting-in speed.
3. Dimly when the dynamo fuse blows.

With coil ignition the lamp lights :—

1. When ignition is switched on.
2. When the dynamo is not charging the battery, or if the engine speed falls below dynamo cutting-in speed.
3. When the engine stops and the battery discharges through the coil.
4. Dimly when the dynamo fuse blows.

On oil-engined chassis the lamp lights:—

1. When the pilot switch is operated.
2. When the dynamo is not charging the battery, or if the engine speed falls below dynamo cutting-in speed.
3. Dimly when the dynamo fuse blows.

In all cases when the main dynamo fuse blows, the lamp continues to light each time the engine is run, until the fuse is replaced.

It should be noted that the lamp lights every time the engine speed falls below dynamo cutting-in speed with the switch on. If it does not the bulb is burned out and should be replaced immediately.

When the dynamo cutting-in speed is reached and the battery is charging the lamp goes out.

" Blue " Oil-Pressure Light.

This indicator is fitted on certain passenger models. The light is operated by an automatic switch in the main oil-pressure system.

The lamp lights :—

1. When the ignition or pilot switch is operated.
2. When the oil pressure falls below 20 lb. per sq. in. in the main oil system, due to a fracture of the oil-pressure system pipes or oil-pressure-gauge pipe.

When the oil pressure is correct and above 20 lb. per sq. in. the lamp goes out. The driver should note also that the lamp should light when the ignition or pilot switch (on oil engines) is operated or with the engine ticking over. If it does not, the bulb is burned out and should be replaced immediately.

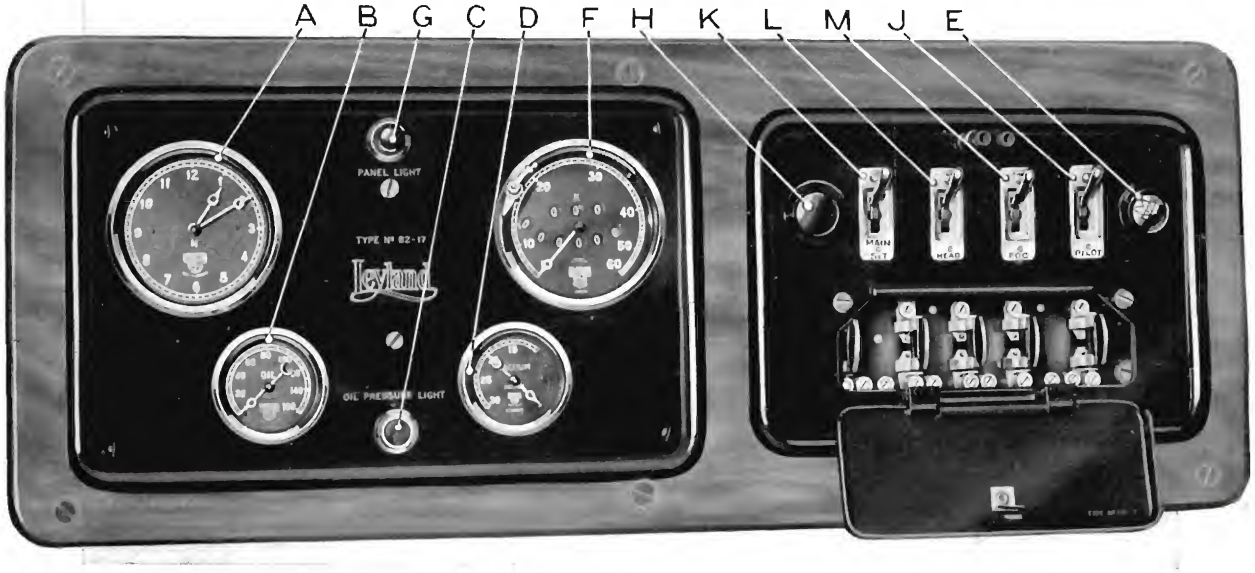


Fig. 6.
Separate Switchboard and Instrument Panel

ELECTRICAL EQUIPMENT

On oil-engined chassis the pilot switch operates the Blue light and this switch should always be switched on when the engine is started.

In the event of fractured oil-pressure-gauge pipe, this can be temporarily remedied by turning off the tap near the engine oil-filler.

Automatic Oil-Pressure Switch.

The switch is fitted directly on the crank-case in the main oil system. It is of simple construction, operating on the Bourdon Ring principle and should give no trouble. The switch is non-adjustable, and in the event of failure a new switch should be fitted after checking that the connections are in order.

FUSES

Fig. 7.
Five-Way Fuse Box.

A separate fuse is provided for each circuit, and all fuses are grouped in accessible positions. In all cases the circuit to which the fuse belongs is clearly indicated.

The arrangement and location of the fuses is clearly shown on the wiring diagram. In the event of a fuse blowing it should be replaced by one of the recommended capacity, as shown on the wiring diagram. If the fuse blows continuously, find out the cause; short circuits in the wiring, internal shorts in the battery or excessive lamp or accessory loads.

Further, to assist in locating fuses, their situation on various machines is given below :—

Main Dynamo-Fuse.

On all passenger machines and all six-cylinder oil-engined machines the main dynamo fuse is on the control board. Cartridge-type fuses (*N*), Fig. 3, are used and a spare fuse (*O*) is housed alongside the main-fuse.

On all goods machines, except those fitted with six-cylinder oil engines, the main dynamo fuse is fitted in the five-way fuse box on the dash, as shown at (*P*), Fig. 7.

Navigation Lights and Auxiliaries Fuses.

On the Titan and three-axle passenger machines, these fuses are situated on the switchboard, as shown in Fig. 6, on all other machines they are in the five-way fuse box.

Interior Lights Fuses.

On the Lion, Tiger and Titan two main fuses for the interior lighting are situated below the switchboard. On all passenger machines the fuses for each interior circuit are housed in the switchboard on the bulkhead. Fuses for destination light and bell are also housed on this board, which is shown in Fig. 8.

STARTER MOTOR

A starter motor is fitted as standard on the Titan, three-axle passenger and all oil-engined machines. The C. A. V. Bosch axial-type starter motor is standardised on all machines except those fitted with four-cylinder petrol engines, in which case a solenoid-operated, clutch-drive type of starter is fitted.

On all oil-engined machines a 24-volt starter motor is used, a series-parallel starter switch, placing the two 12-volt batteries in series for starting purposes and in parallel for charging and lighting at 12 volts.

It is essential for satisfactory operation, particularly with oil-engines that the battery is kept in a fully charged condition.

The ignition control lever should always be in the full retard position when starting and when starting from cold the engine should first be turned by hand. **If the engine fails to start do not keep the starter motor engaged for an undue length of time but find the cause of failure to start—check ignition and petrol supply.** On oil-engined machines the starter must be kept running until the engine is properly started, but it should not be engaged for longer than is absolutely necessary to obtain a start.

A few simple precautions observed when using starter motors, particularly the axial type, will prevent undue wear of the pinion and flywheel ring.

Fig. 8
Interior Switchboard.

ELECTRICAL EQUIPMENT

When the starter has been engaged and the engine turned over but failed to start, it is most important to make sure that both the flywheel and pinion are stationary before re-engaging the starter. When both pinion and flywheel are stationary the starter can be re-engaged without the damaging effect of a back-running flywheel and a fast-revolving pinion.

The starter pinion is made of phosphor-bronze, so that it will wear in preference to the flywheel ring, and neglect of the above precautions will cause rapid destruction of the teeth.

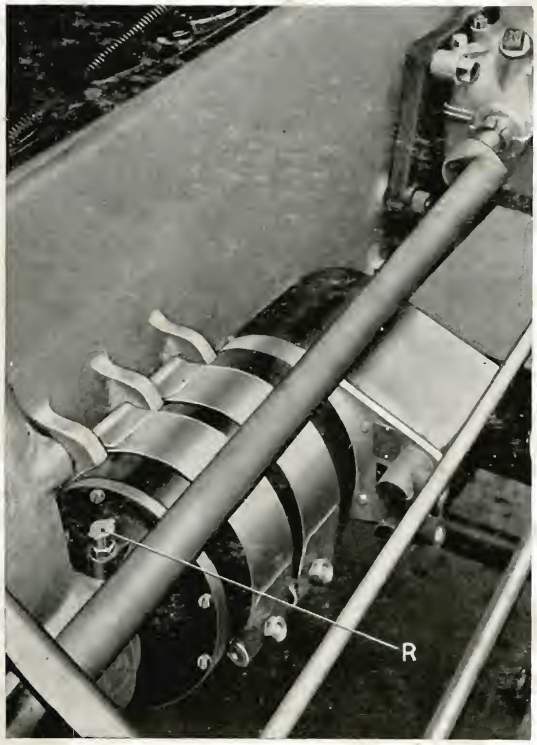


Fig. 9.
Starter Motor.

Care of Starter Motor.

A few drops of engine oil should be given periodically through the oil cup (*R*), Fig. 9, on all types of starter except that fitted on four-cylinder petrol engines. This type is graphite lubricated and only requires attention at overhaul.

Removal of Starter Motor.

On the larger engines, the starter is located in the engine bell-housing on a spigot and secured by two straps on the offside of the engine. To remove the starter, disconnect the cables and remove the bolts from the straps. The starter can then be drawn clear of the spigot. On side-type machines the starter can easily be removed from below.

On the " Light-Six " engines, the starter is flanged and secured to the near-side of the bell-housing by three studs. To remove the starter, disconnect the cables and remove the three nuts on the flange. Draw the starter forwards off the studs and when the pinion clears the bell-housing, lift out upwards.

It is advisable to disconnect the starter cable from the battery when removing the starter.

The starter motor should only be overhauled by an expert, but the brush gear and commutator can be inspected when the engine is being overhauled. Keep the connections tight. If the pinion becomes worn it can be removed by taking off the lock-nuts and drawing the pinion off the starter spindle. When fitting a new pinion make sure that it is a good fit on the spindle and that the nuts are tight. When replacing the starter, press well home in the spigot and well tighten the securing nuts.

F R O S T P R E C A U T I O N S .

The following precautions must be taken during frosty weather to obviate any damage to the vehicle due to freezing of the cooling system.

1. Whenever frost precautions are ordered, the cooling system must be completely drained. It is not sufficient merely to close the radiator shutters, or to cover the cooling system with muffs.

2. The vehicle should be on level ground when being drained. If it is impossible to have the vehicle level, the nearside must be lower than the offside.

3. The cooling system is fitted with three drain cocks, all of which must be opened to drain the system completely.

4. Drain cocks are positioned as follows:-
   Nearside, beneath radiator
   Nearside, at rear of cylinder block
   Offside, at front of cylinder block

5. Drain cocks must be tested at frequent intervals by inserting a piece of wire.